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THE JOURNAL OF ENGINEERING EDUCATION

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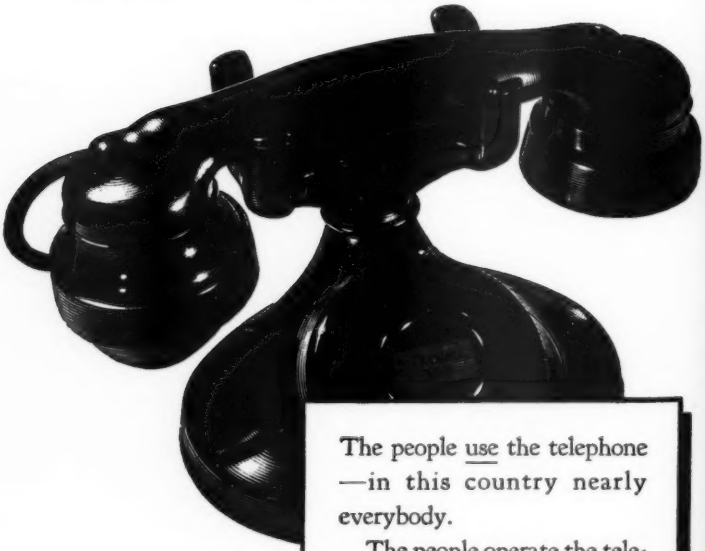

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Published under the Supervision of the Publication Committee.
K. T. Compton, S. B. Earle, F. L. Bishop, Editor, University of Pittsburgh.
Published at Prince and Lemon Sts., Lancaster, Pa.

Entered as second-class matter at the Post Office at Lancaster, Pa., under the Act of March 3, 1870.

New Series, Vol. XXIX, No. 5 | JANUARY, 1939 | Subscription Price, $3.00 per year. Single Copies, 50 cents

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THE PENNSYLVANIA STATE COLLEGE

By J. E. KAULFUSS

Professor of Highway Engineering

The Pennsylvania State College, more popularly known as and commonly called "Penn State," is looking forward anticipatively to the coming of the Society to its campus in June.

It is of interest to note that, among those who have been chiefly instrumental in the development of engineering education at Penn State in its early years, the most influential was Josiah Jackson, then Professor of Mathematics, who partly at his own expense in 1882–83 started regularly organized programs of study in civil engineering, shop work, and drawing. Two of Professor Jackson's sons, who spent their childhood on the campus and attended the college, later took prominent parts in engineering education and in the work of the Society. One, John Price Jackson, was Dean of the School of Engineering from 1895 to 1905, while the other, Dugald C. Jackson, was President of the Society for the Promotion of Engineering Education for 1906–07 and Lamme Medalist in 1931.

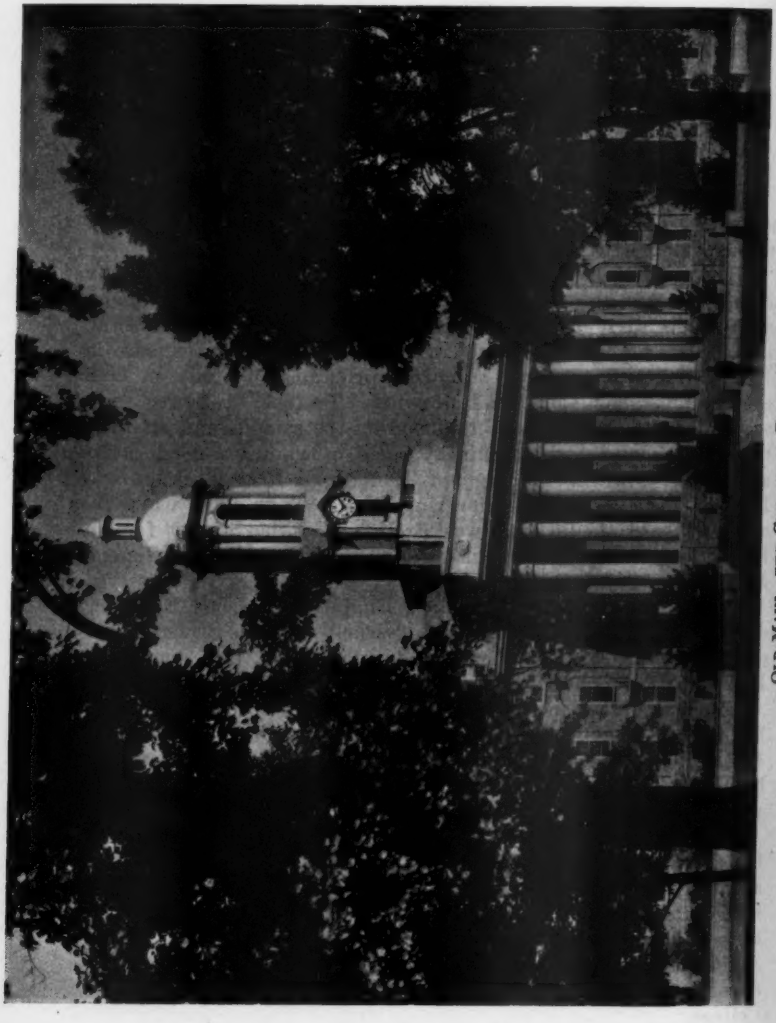
All the deans of the School of Engineering, Louis E. Reber, John Price Jackson, and Robert L. Sackett who was Society President for 1927–28 and Lamme Medalist in 1938, and incumbent, Harry P. Hammond, continue as active members in the S. P. E. E.

Penn State, essentially the Commonwealth's state university, had its beginning as the Farmers' High School of Pennsylvania in 1855. Education for youth was to be provided in the various branches of science, learning, and practical agriculture. In a few years it became The Agricultural College of Pennsylvania.

On April 1, 1863, the State Legislature passed an act accepting the provisions and obligations of the Morrill Land-Grant Act and thus the College became the State institution of higher learning in Pennsylvania in the same sense as are the land-grant colleges and universities of the other states of the Union.

It was in 1875 that the institution's charter was amended changing its name to the present one of The Pennsylvania State College.

State College, the institution, is located at State College, the borough and post-office. It lies in the center of the broad, rolling farming valley between the widely known Seven Mountains and



OLD MAIN—THE CENTER OF PENN STATE
Registration Headquarters for the S. P. E. E.

OLD MAIN—THE CENTER OF PENN STATE
Registration Headquarters for the S. P. E. E.

MAIN ENGINEERING BUILDING
At the Gateway of the Penn State Campus.

Bald Eagle Mountain which marks the beginning of the Alleghenies farther to the north and west. Three miles to the east stands Nittany Mountain, repeatedly mentioned in the songs, lore, and traditions of the institution.

The campus and surrounding Nittany Valley elevation are about 1,200 feet above sea level. Bald Eagle, Nittany, and Bald Knob of the Tussey Mountains have elevations of from 2,200 to 2,400 feet above sea level. These heights may be reached by hiking trails and by roads. State fire towers and natural look-out points provide panoramic views of extensive forests and valleys and mountain streams.

The climate is ideal; the air invigorating, the summer nights in State College being consistently cool. There are no mosquitoes.

State College is near the geographical center of the state. It is about ten miles from Bellefonte, the seat of Center County. Tyrone, Lewistown, and Altoona on the Pennsylvania Railroad are 30 and 40 miles away and can be reached by good roads and bus lines. The nearest Pennsylvania Railroad Station is the village of Lemont, three miles distant.

Lock Haven, on the New York Central, is 35 miles away.

State College is about 200 miles from Washington, Baltimore, Philadelphia, and Buffalo. It is less than 300 miles to New York City, 90 miles from Harrisburg, and 145 miles from Pittsburgh.

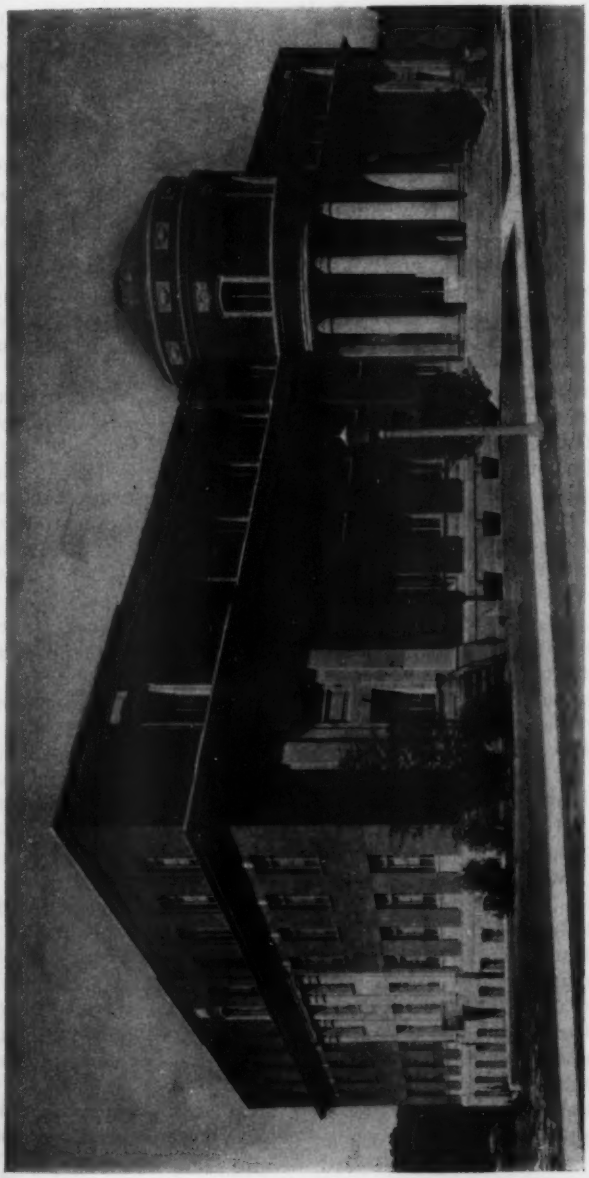
It has a landing field and is on U. S. Route 322 which is the Lakes-to-the-Sea Highway from Erie to Philadelphia.

State College is a thriving municipality of 13,000 or more, of whom one half are students of the College. One peculiar feature of the town is that the student and resident populations have consistently remained equal. Its places of business are modern; its movies are up-to-date.

Beyond a small stone quarry and an ice cream plant, State College has no industries. It is a community of businesses, professions, education, and homes. Its streets are surfaced and well-lighted. Its water supply comes from mountain streams six miles distant and from local wells in limestone formation.

State College is an orderly town. With its many good homes, generally well-landscaped, it is an attractive place in which to live or to visit. One unique feature of the town is the "fraternity section" in which are located most of the houses, many of which are recently built, of a great number of the 50 or more fraternities in the College. Only a few fraternities have their houses on the campus.

Hard roads, mountains, state parks, picnic places, scenic points, caves (one of which is reputedly the only water cave opened for visiting), the Fisherman's Paradise at Bellefonte, etc., are among



MINERAL INDUSTRIES BUILDING

The only School of its character in America uniting every branch of mineral industries instruction, research, and extension.

the many points of interest abounding in Center County and Central Pennsylvania.

Penn State, the institution, has a present enrollment of 6,500 which is double that of fifteen years ago. At the present time, the ratio of women to men students is about 1 out of 5, whereas fifteen years ago it was about 1 out of 10.

Eighteen hundred freshmen were admitted in September, 1938, and nearly that many more as applicants were unadmitted. One distinctive thing about Penn State is the degree of high selectivity, students accepted being generally those in the upper three-fifths of their high school classes. Another feature is the exceedingly high percentage of graduations of those who enter, especially among the women students. A further particular point about the present enrollment is that the senior class is so large compared to the freshman, 1,267 to 1,820.

The institution has seven undergraduate schools, a Department of Military Science and Tactics, and the Graduate School. Forty-three different curricula or courses of study are offered.

Enrollments in Schools are: about 1,500 in the School of Liberal Arts, 1,300 in Agriculture, over 1,000 in Engineering, and 700 in Chemistry and Physics. In the last are included 302 students taking chemical engineering. There are 300 students in the School of Mineral Industries. The other Schools are School of Education and the School of Physical Education and Athletics.

The Graduate School has about 500 students of whom 80 are in engineering (26 mineral industries, 25 chemistry and physics, 24 engineering proper, and 5 in agriculture).

The summer session enrollment of the College is the largest in Pennsylvania, being over 3,000.

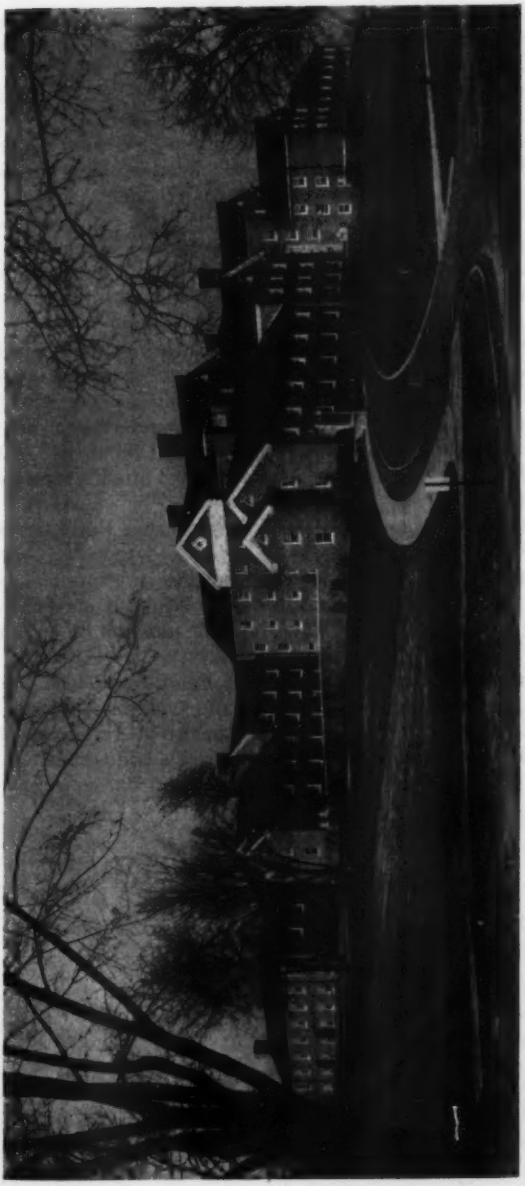
The Pennsylvania State College is also active and noted for research in agriculture, engineering, chemical engineering, and mineral industries, and in extension services to over 10,000 persons in arts and science, engineering, mineral industries, and teacher training. As a state, Pennsylvania ranks first or second in industry, and is sixth in agriculture.

The College staff comprises about 900 persons engaged in administration, teaching, research, and extension.

There are over 1,700 engineering students in the four Schools giving engineering education in 14 technical curricula.

In the School of Engineering, enrollments by departments are: Architecture and Architectural Engineering 70, Civil Engineering 110, Electrical Engineering 270, Industrial Engineering 200, and Mechanical Engineering 380.

The College land holdings exceed 2,000 acres. The main campus of approximately 200 acres is flanked on one side by the Col-



FRANCIS ATHERTON HALL

The most recent dormitory at Penn State, housing 500 women—to be used as one of the quarters for those attending the Society meeting in June, 1939.

lege 18-hole-golf course and on the other by the College farms, orchards, and agriculture experiment grounds, which include the oldest experimental plots in the United States.

The main street of the town, College Avenue and State Route 45, the business section of town, the larger residential portion of the borough, including the "fraternity section" referred to, are on a third side of the campus, while a restricted residential section called College Heights is on the fourth or north side.

There are more than 50 buildings on the main campus, the majority of which are modern fire-proof structures. During the past decade or slightly more, about $5,500,000 was put into new buildings, bringing the total valuation of plant and equipment to over $10,000,000.

During the past year under the State Authority, and scheduled for completion before July 1939, a construction program involving thirteen buildings and projects and amounting to over $5,000,000 has been well under way. This and other undertaken improvements will increase the College valuation to about $16,500,000. The eleven buildings under this Authority are already one by one nearing completion.

Among these is the new Electrical Engineering Building, which will cost over $405,000.

As stated above, State College is near the geographical center of the state and, with Pennsylvania's good roads, it may therefore be reached from all parts of the state by automobile within six hours.

The officials, faculty, and friends of Penn State look forward to the June meeting of the S. P. E. E. and trust that all who may attend will come to appreciate more the great resources of the Commonwealth of Pennsylvania, which are its industries, its agriculture, its minerals, its education, its folk, and its scenery.

ENGINEERING ENROLLMENTS, 1938–39

150 institutions giving instruction in engineering were requested to furnish the following information. 122 had replied as of December 22, 1938.

Engineering Courses	Freshmen (1st year)	Sophomores (2nd year)	Juniors (3d year)	Seniors (4th year)	5th Year (of 5-yr. Curriculum)	Special Students	Evening Students	Others	Totals	No. of First Degrees Conferred During the Academic Year 1937–38
Aeronautical	623	518	456	379	16	4	88	——	2,084	280
Agricultural	284	215	188	182	——	——	——	——	867	124
Architectural	287	274	167	159	24	3	——	——	922	112
Ceramic	62	131	89	74	——	30	——	——	386	39
Chemical	3,287	3,485	2,922	2,207	88	24	489	2	12,538	1,573
Civil	3,186	2,316	2,386	1,809	91	23	745	——	10,585	1,572
Electrical	3,136	3,502	3,067	2,351	92	48	879	——	13,135	1,751
Industrial	272	505	463	388	41	4	155	——	1,828	298
Mechanical	4,665	5,465	4,645	3,272	183	87	1,409	240	20,014	1,912
Metallurgical	341	584	512	392	——	4	182	——	2,015	311
Mining	407	404	391	314	——	5	——	——	1,521	223
Unclassified	9,363	2,827	1,713	1,098	——	62	3,035	108	18,206	753
Totals (122 Institutions)	25,911	20,406	16,999	12,625	535	294	6,982	350	84,002	*8,948
Totals 1937–38 (131 Institutions)	27,713	20,646	15,618	11,887	624	353	7,341	575	84,547	†8,245

* 115 Institutions reporting.

† 103 Institutions reporting.

Undergraduate Enrollment by Institutions

Institution	Freshmen (1st year)	Sophomores (2nd year)	Juniors (3d year)	Seniors (4th year)	5th Year (of 5-yr. Curriculum)	Special Students	Evening Students	Others	Totals	No. of First Degrees Conferred During the Academic Year 1937–38	Enrollment 1937–38
Akron U.	96	33	33	39	27	4	—	—	232	20	200
Ala. Poly.	285	214	195	181	3	8	—	10	896	149	852
Ala. U.	288	188	151	90	—	3	85	—	805	77	687
Arizona U.	128	71	81	64	—	9	—	—	353	33	352
Arkansas U.	97	121	63	44	—	—	—	—	325	33	318
Armour Inst.	316	246	207	130	—	46	1,518	236	2,699	138	3,020
Brooklyn Poly.	160	126	107	110	—	—	1,234	—	1,737	120	1,565
Brown U.	59	33	34	29	—	—	—	—	155	24	141
Bucknell U.	97	64	50	33	—	2	—	—	246	17	179
Cal. Inst. Tech.	78	79	114	96	—	—	—	—	367	101	453
Cal. U.	367	297	471	407	—	—	—	—	1,542	268	1,370
Carnegie Tech.	326	290	251	193	—	3	843	—	1,906	192	2,069
Case School	292	254	201	169	—	—	466	—	1,382	127	1,515
Catholic U.	72	37	30	18	—	10	—	—	167	23	119
Cincinnati U.	385	285	276	177	148	—	—	—	1,271	73	1,531
Citadel	50	46	36	29	—	—	—	—	161	24	156
Clarkson	159	116	89	60	—	—	—	—	424	46	356
Clemson	303	194	124	81	—	—	—	—	702	56	676
Colorado Mines	239	216	184	128	—	—	—	—	767	99	703

Enrollment by Institutions—Continued

Enrollment by Institutions—Continued

Institution	Freshmen (1st year)	Sophomores (2nd year)	Juniors (3d year)	Seniors (4th year)	5th Year (of 5-yr. Curriculum)	Special Students	Evening Students	Others	Totals	No. of First Degrees Conferred During the Academic Year 1937–38	Enrollment 1937–38
Columbia	128	154	116	56	—	6	—	—	460	56	416
Conn. State	76	26	14	6	—	—	—	—	122	12	92
Dartmouth	—	—	—	12	6	—	—	—	18	19	80
Dayton U.	60	55	42	32	—	3	104	—	296	20	203
Delaware	86	62	38	26	—	5	—	—	217	22	178
Detroit U.	238	153	222	59	—	4	26	—	702	45	605
Drexel	303	204	134	108	99	4	—	—	852	85	836
Duke U.	82	72	22	24	—	1	—	—	201	26	162
Florida U.	—	—	109	86	—	—	—	—	195	60	211
George Wash. U.	150	75	73	64	—	—	—	—	362	33	340
Georgia Tech.	687	575	462	294	—	—	—	—	2,018	230	1,958
Gettysburg Col.	—	8	5	4	—	—	—	—	17	4	53
Harvard Col.	—	43	39	29	—	—	8	—	119	27	—
Hawaii U.	59	28	8	4	—	—	—	—	99	12	78
Howard U.	19	7	3	5	—	—	—	—	34	4	36
Idaho U.	136	89	70	74	—	4	—	—	373	51	519
Illinois U.	828	648	556	395	—	—	—	82	2,509	290	2,378
Iowa State Coll.	682	471	315	296	—	—	—	—	1,764	182	1,569
John Hopkins	80	102	84	51	—	—	453	—	770	51	308

Enrollment by Institutions—Continued

Institution	Freshmen (1st year)	Sophomores (2nd year)	Juniors (3d year)	Seniors (4th year)	5th Year (of 5-yr. Curriculum)	Special Students	Evening Students	Others	Totals	No. of First Degrees Conferred During the Academic Year 1937–38	Enrollment 1937–38
Kansas Coll.	324	280	213	175	—	—	—	—	992	145	1,007
Kansas U.	172	157	143	136	—	2	—	—	610	105	668
Kentucky U.	143	119	90	60	—	—	—	—	412	56	403
Lehigh U.	390	341	228	192	—	—	—	22	1,173	171	1,110
Lewis Inst.	88	65	37	29	—	9	332	—	560	38	1,035
Louisiana St.	—	218	222	134	—	8	4	—	586	94	458
Louisville U.	99	47	38	39	—	—	—	—	223	30	168
Maine U.	178	133	104	59	—	9	—	—	483	60	445
Manhattan Coll.	93	62	65	35	—	—	—	—	255	36	217
Marquette U.	126	122	190	66	—	3	—	—	507	—	541
Maryland U.	234	124	68	41	—	6	—	—	473	42	351
Mass. Inst. Tech.	573	455	505	454	—	—	—	—	1,987	346	1,912
Michigan M. & T.	199	209	150	148	—	16	—	—	722	108	679
Michigan Coll.	296	204	165	128	—	3	—	—	796	100	754
Michigan U.	517	489	559	517	—	10	1	—	2,058	343	1,858
Miss. Coll.	249	176	162	138	—	2	—	—	727	91	804
Miss. U.	19	19	11	9	—	—	—	—	58	7	61
Missouri Mines	247	191	168	128	—	—	—	—	734	95	629
Missouri U.	146	153	128	71	—	—	—	—	498	49	480
Montana Coll.	170	136	67	66	—	—	—	—	439	50	392
Montana Mines	92	112	58	37	—	1	—	—	300	24	294
Nebraska U.	306	236	125	123	2	—	—	—	792	65	733
Newark Coll.	223	184	130	126	—	—	148	—	811	129	773

Enrollment by Institutions—Continued

Nebraska U.	306	236	125	123	2	—	—	—	792	65	733
Newark Coll.	223	184	130	126	—	—	148	—	811	129	773

Enrollment by Institutions—Continued

Institution	Freshmen (1st year)	Sophomores (2nd year)	Juniors (3d year)	Seniors (4th year)	5th Year (of 5-yr. Curriculum)	Special Students	Evening Students	Others	Totals	No. of First Degrees Conferred During the Academic Year 1937–38	Enrollment 1937–38
New Brunswick	38	32	12	13	—	—	—	—	95	13	—
New York U.	253	241	176	155	—	—	1,189	—	2,014	215	—
N. Hampshire U.	125	106	69	65	—	3	—	—	368	56	375
N. Mexico Coll.	145	53	41	27	—	1	—	—	267	24	191
N. Mexico U.	72	52	33	21	—	2	—	—	180	—	171
N. Carolina St. C.	472	265	204	143	—	1	—	—	1,040	96	928
N. Dakota Agri.	78	75	62	50	—	—	—	—	265	31	355
N. Dakota U.	99	92	33	33	1	39	—	—	297	34	312
Northeastern U.	413	318	236	133	144	—	—	—	1,244	153	1,180
Norwich U.	56	35	27	18	—	—	—	—	136	15	114
Notre Dame U.	151	124	82	73	—	—	—	—	430	60	436
Ohio St. U.	524	548	446	344	8	—	—	—	1,870	241	2,003
Okla. A. & M.	464	281	242	176	9	6	—	—	1,178	118	1,008
Oregon St. Coll.	277	211	155	129	—	—	—	—	772	100	841
Penna. St. Coll.	480	446	414	306	—	—	—	—	1,646	213	1,532
Penna. U.	114	132	93	75	—	—	—	—	414	61	388
Pittsburgh U.	297	236	197	162	—	12	144	—	1,048	—	1,049
Princeton U.	125	83	64	61	—	—	—	—	333	—	294
Purdue U.	1,184	994	824	602	—	7	—	—	3,611	—	3,433
Renesselaer	410	352	240	188	—	4	—	—	1,194	189	1,130
Rhode I. St.	109	84	61	51	—	—	—	—	305	48	280
Rice Inst.	184	132	94	71	—	—	—	—	481	37	430

Enrollment by Institutions—Continued

Institution	Freshmen (1st year)	Sophomores (2nd year)	Juniors (3d year)	Seniors (4th year)	5th Year (of 5-yr. Curriculum)	Special Students	Evening Students	Others	Totals	No. of First Degrees Conferred During the Academic Year 1937–38	Enrollment 1937–38
Rochester U.	48	45	21	35	—	—	57	—	206	14	158
Rose Poly.	105	66	45	28	—	—	—	—	244	34	218
Rutgers U.	83	66	39	26	—	5	—	—	219	26	215
Santa Clara U.	34	29	16	13	—	—	—	—	92	7	87
So. Dak. Mines	125	106	75	47	—	—	—	—	353	41	318
Southern Cal.	61	74	114	89	18	4	250	—	611	55	291
So. Meth. U.	70	39	23	16	14	—	—	—	162	12	172
Stanford U.	87	154	69	85	—	—	—	—	395	90	356
Stevens Inst.	186	167	113	93	—	—	—	—	559	92	525
Swarthmore Coll.	20	19	17	13	—	—	—	—	69	—	65
Syracuse U.	165	116	90	69	—	2	—	—	442	55	415
Tenn. U.	198	178	124	79	—	5	—	—	484	—	—
Tex. Tech. C.	380	208	114	115	—	—	—	—	817	62	56
Texas Arts & Ind.	85	56	38	24	—	—	—	—	203	13	—
Texas A. & M.	1,274	767	475	314	2	2	—	—	2,834	173	2,417
Texas U.	546	457	315	261	—	—	—	—	1,579	157	1,494
Toledo U.	134	72	54	37	—	11	120	—	428	22	294
Tufts Col.	113	100	93	81	—	—	—	—	387	53	366
Tulane U.	145	79	49	46	—	1	—	—	320	52	286
Union Coll.	76	47	29	20	—	—	—	—	172	24	200
Utah U.	140	114	88	56	—	—	—	—	398	43	464
Valparaiso U.	36	25	14	6	—	—	—	—	81	9	76
Vanderbilt U.	69	59	39	33	—	—	—	—	200	25	185

Valparaiso U.	36	25	14	6	—	—	—	—	81	9	76
Vanderbilt U.	69	59	39	33	—	—	—	—	200	25	185

Enrollment by Institutions—Continued

Institution	Freshmen (1st year)	Sophomores (2nd year)	Juniors (3d year)	Seniors (4th year)	5th Year (of 5-yr. Curriculum)	Special Students	Evening Students	Others	Totals	No. of First Degrees Conferred During the Academic Year 1937–38	Enrollment 1937–38
Vermont U.	49	33	25	21	—	1	—	—	129	18	113
Villanova Coll.	81	56	44	22	—	—	—	—	203	27	—
Virginia M. I.	155	156	116	128	—	—	—	—	555	99	147
Virginia Poly.	630	390	258	221	—	3	—	—	1,502	184	1,295
Virginia U.	99	63	38	41	—	2	—	—	243	17	209
Wash. St. Col.	233	158	108	111	—	—	—	—	610	70	463
Wash., U. of	602	269	262	228	—	—	—	—	1,361	174	1,503
Webb Inst.	19	16	16	13	—	—	—	—	64	10	—
West Va. U.	203	144	98	72	—	—	—	—	517	60	451
Wisconsin U.	416	471	344	266	—	—	—	—	1,497	169	1,375
Worcester Poly.	167	187	127	89	27	—	—	—	597	83	685
Wyoming U.	142	78	58	62	—	1	—	—	341	25	326
Yale U.	—	78	79	67	—	—	—	—	224	52	217
	25,444	19,988	16,701	12,420	508	293	6,982	350	82,585	8,697	73,945
Canadian Schools											
Ecole Poly.	112	64	43	30	27	—	—	—	276	34	274
New Brunswick	38	32	12	13	—	—	—	—	95	13	—
Queen U.	186	169	160	125	—	1	—	—	641	96	622
Sask. U.	172	125	75	33	—	—	—	—	405	34	352
Grand Totals	25,952	20,378	16,991	12,621	535	294	6,982	350	84,002	8,946	75,193

Enrollment of Graduate Engineering Students, 1938–39

Institutions	Enrollment for Work in Master's Degree						Enrollment for Work in Doctor's Degree					
	Full-Time Resident Students	Part-Time Resident Students	Evening Students	Others	Totals	Master's Degrees Conferred 1936–37	Full-Time Resident Students	Part-Time Resident Students	Evening Students	Others	Totals	Doctor's Degrees Conferred 1936–37
Ala. U.	5	2	—	7	2	—	—	—	—	—	—	—
Ariz. U.	10	2	—	12	9	—	—	—	—	—	—	—
Armour Tech.	9	27	275	—	311	5	2	3	—	—	5	—
Brooklyn	10	—	260	—	270	20	—	—	9	—	9	—
Brown U.	—	3	—	—	3	—	—	1	—	—	1	—
Bucknell	1	1	—	—	2	—	—	—	—	—	—	—
Cal. I. T.	81	6	—	—	87	66	22	1	—	—	23	6
Cal. U.	104	—	—	—	104	35	—	1	—	—	1	3
Cal. U., S.	5	13	21	—	39	3	—	—	—	—	—	1
Case	14	77	67	—	158	16	3	3	—	—	6	—
Carnegie T.	18	4	110	—	132	14	9	—	—	—	9	—
Catholic U.	1	11	—	—	12	—	—	—	—	—	—	—
Colo. Mines	11	—	—	—	11	3	3	—	—	—	3	1
Columbia	59	33	—	11	103	76	—	—	—	—	—	2
Cornell	52	—	—	—	52	29	23	—	—	—	23	4
Detroit	639	24	26	13	702	—	—	—	—	—	—	—
Florida	2	—	—	—	2	—	—	—	—	—	—	—
Ga. Tech.	—	31	—	—	31	6	—	—	—	—	—	—
Harvard	108	22	—	—	130	50	18	11	—	—	29	6

Harvard	108	22	—	—	130	50	18	11	—	—	29	6

Enrollment of Graduate Engineering Students, 1938–39—Continued

Institutions	Enrollment for Work in Master's Degree						Enrollment for Work in Doctor's Degree					
	Full-Time Resident Students	Part-Time Resident Students	Evening Students	Others	Totals	Master's Degrees Conferred 1936–37	Full-Time Resident Students	Part-Time Resident Students	Evening Students	Others	Totals	Doctor's Degrees Conferred 1936–37
Idaho	16	—	—	—	16	25	—	—	—	—	—	—
Illinois	34	59	—	—	93	40	7	44	—	1	52	5
Iowa	18	24	—	—	42	16	3	15	—	—	18	6
Kansas St.	3	13	—	5	21	5	—	—	—	—	—	—
Kansas U.	5	—	—	—	5	2	—	—	—	—	—	—
Kentucky U.	3	—	—	—	3	7	—	—	—	—	—	—
La. St. U.	22	5	—	—	27	8	—	—	—	—	—	—
Louisville	6	2	15	—	23	6	—	—	—	—	—	—
Lehigh	8	28	—	—	36	15	2	3	—	—	5	4
Maine	3	5	—	—	8	5	—	—	—	—	—	—
Marquette	126	122	100	90	438	66	—	3	—	—	3	—
Maryland	4	—	—	—	4	—	2	—	—	—	2	—
M. I. T.	341	—	—	—	341	182	101	—	—	—	101	30
Mich. Mines	5	—	—	—	5	—	—	—	—	—	—	—
Mich. St.	5	13	—	—	18	2	—	—	—	—	—	—
Miss. St.	—	3	—	—	3	—	—	—	—	—	—	—
Mo. Mines	8	—	—	—	8	4	6	—	—	—	6	—
Mont. Mines	19	—	—	—	19	5	—	—	—	—	—	—
Mont. St.	2	—	—	—	2	2	—	—	—	—	—	—
Nebraska	5	—	—	—	5	—	1	—	—	—	1	—
N. Hampshire	—	3	—	—	3	6	—	—	—	—	—	—

Enrollment of Graduate Engineering Students, 1938–39—Continued

Institutions	Enrollment for Work in Master's Degree						Enrollment for Work in Doctor's Degree					
	Full-Time Resident Students	Part-Time Resident Students	Evening Students	Others	Totals	Master's Degrees Conferred 1936–37	Full-Time Resident Students	Part-Time Resident Students	Evening Students	Others	Totals	Doctor's Degrees Conferred 1936–37
Newark	—	—	14	—	14	—	—	—	—	—	—	—
N. Carolina	8	18	—	—	26	3	—	—	—	—	—	—
N. Dak.	4	—	—	—	4	—	—	—	—	—	—	—
New York U.	24	21	158	—	203	13	1	10	—	—	—	11
Ohio St. U.	44	10	—	—	54	23	27	6	—	—	33	5
Okla. A. & M.	9	1	—	1	11	2	—	—	—	—	—	—
Ore. St.	2	4	—	—	6	3	—	—	—	—	—	—
Penn. St.	9	54	—	—	63	6	2	12	—	—	14	1
Penn. U.	6	2	71	—	79	10	1	3	—	—	4	3
Princeton	16	—	—	—	16	—	—	—	—	—	—	—
Purdue	73	—	—	12	85	17	19	—	—	—	19	2
Pgh. U.	—	138	—	—	138	—	—	9	—	—	9	—
Rensselaer	27	—	—	—	27	8	1	—	—	—	1	1
R. I. St.	—	1	—	—	1	—	—	—	—	—	—	—
Rice Inst.	3	—	—	—	3	—	—	—	—	—	—	—
Rochester	2	5	—	—	7	2	—	—	—	—	—	—
Rutgers U.	3	6	—	—	9	—	—	—	—	—	—	—
So. Dak.	—	4	—	—	4	—	—	—	—	—	—	—
Stanford	—	—	—	—	—	26	89	—	—	—	89	1
Stevens	5	26	228	—	259	5	—	—	—	—	—	—
Syracuse	1	8	—	—	9	1	—	—	—	—	—	—

Enrollment of Graduate Engineering Students, 1938–39—Continued

Enrollment of Graduate Engineering Students, 1938–39—Continued

Institutions	Enrollment for Work in Master's Degree						Enrollment for Work in Doctor's Degree					
	Full-Time Resident Students	Part-Time Resident Students	Evening Students	Others	Totals	Master's Degrees Conferred 1936–37	Full-Time Resident Students	Part-Time Resident Students	Evening Students	Others	Totals	Doctor's Degrees Conferred 1936–37
Tenn. U.	14	59	—	—	73	11	—	—	—	—	—	—
Tex. Tech. C.	5	—	—	—	5	1	—	—	—	—	—	—
Texas A. & M.	7	25	—	—	32	12	—	6	—	—	6	—
Texas U.	15	17	—	—	32	9	4	6	—	—	10	—
Tulane U.	7	2	—	—	9	1	—	—	—	—	—	—
Vermont	—	—	—	—	—	1	—	—	—	—	—	—
Va. Poly. T.	54	10	—	—	64	23	—	—	—	—	—	—
Va. U.	3	—	—	—	3	2	—	—	—	—	—	—
Wash. St.	6	—	—	—	6	—	—	—	—	—	—	—
Wash., U. of	30	—	—	—	30	10	2	—	—	—	2	1
W. Va. U.	—	14	—	—	14	—	—	—	—	—	—	—
Wis. U.	19	10	4	—	33	16	4	5	—	—	9	2
Worcester	9	6	—	—	15	4	—	—	—	—	—	4
Yale	26	—	—	1	27	8	22	—	—	—	22	4
U. S. Schools Totals	2,213	974	1,349	133	4,649	1,156	374	142	9	1	526	92
Canadian Schools												
Sask.	—	1	—	—	1	—	—	—	—	—	—	—
Queen	—	1	—	—	1	—	—	—	—	—	—	—
Ecole	—	1	—	—	1	—	—	—	—	—	—	—
Totals	2,213	977	1,349	133	4,652	1,156	374	142	9	1	526	92

PREDICTING THE SCHOLASTIC ACHIEVEMENT OF ENGINEERING STUDENTS

By D. D. FEDER, Assistant Director, Personnel Bureau, University of Illinois
AND
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The problem of selecting the most promising candidates and eliminating the unfit early in the training period continues to receive primary attention in engineering literature. Considerable study has been made of tests and techniques which will serve such functions.

Freshmen in the College of Engineering of the State University of Iowa take the Iowa Qualifying Examinations, consisting of the Iowa High School Content Examination, the Iowa Silent Reading Test, and the Mathematics Aptitude and English Training tests of the Iowa Placement series. The present study was undertaken to determine the relative efficiency of each of these tests in predicting academic success (grade point achievement) in the College of Engineering. The measure of academic success was the average of honor points earned. The following point values are assigned to the various grades: A = 4; B = 3; C = 2; D = 1; Fd = 0.

The records of students who entered the College of Engineering as freshmen in September, 1931, were used. Of these 108 students, 99 (designated as Group I) remained at least one semester; 84 (designated as Group II) remained at least one year; 26 (designated as Group III) were graduated by June, 1936. The other nine students left school before the end of the first semester because of poor health, finances, etc. Although the present report is based upon data of a single group, repetition of fundamental procedures for other groups has yielded exactly comparable results.

The data of Table 1 indicate that the tests, individually and as a battery, have satisfactory validity for predicting first year achievement. In general, prediction coefficients in education range between .40 and .60. Therefore these, which begin at .60, may be considered a marked improvement.

The Mathematics Aptitude Test appears to be the best single measure, yielding predictions of actual numerical grade averages 31 per cent better than chance for first semester achievement.

Table 2 has been inserted at this point to permit the evaluation of coefficients of correlation which represent prognostic power.

TABLE 1

PREDICTION OF FIRST SEMESTER AND FIRST YEAR ACHIEVEMENT BY THE IOWA QUALIFYING EXAMINATIONS *

Group	Variables	1	2	3	4	5	
I.....	6	.69±.04	.57±.05	.72±.03	.62±.04	.74±.03	$N=99$
II.....	7	.69±.04	.50±.05	.69±.04	.60±.05	.71±.04	$N=84$

Variables:

1. Iowa High School Content Examination.
2. Iowa Silent Reading Test.
3. Mathematics Aptitude Test.
4. English Training Test.
5. Composite (Based on the four tests).
6. First Semester Grade Point Average.
7. First-year Grade Point Average.

N Number of cases.

* The coefficient of correlation is a quantitative expression of the relationship between two variables. Its range is from 0 indicating no relationship to 1.00 indicating perfect relationship. The sign of the coefficient is positive if the relationship is direct, and negative if the relationship is inverse.

TABLE 2 *

SHOWING, FOR VARIOUS AMOUNTS OF CORRELATION, THE CHANCES IN 100 THAT THE SECOND MEASURE OF AN INDIVIDUAL WILL BE IN THE SAME "TENTH" OF A DISTRIBUTION, NOT DISPLACED MORE THAN 1 "TENTH," 2 "TENTHS," ETC.

Coefficient of Correlation	Number of "Tenths" Displacement							
	0	1	2	3	4	5	6	7
.00.....	19	53	77	91	97	99.2	99.8	99.9+
.10.....	20	55	79	92	98	99.4	99.9	
.20.....	21	58	82	94	98	99.6	99.9+	
.30.....	22	61	85	95	99.0	99.8	99.9+	
.40.....	24	64	88	97	99.5	99.9+		
.50.....	26	69	91	98	99.7	99.9+		
.60.....	29	73	94	99.2	99.9+			
.70.....	34	81	97	99.8	99.9+			
.80.....	41	89	99.2	99.9+				
.90.....	55	98	99.9+					
.95.....	71	99.9+						
.98.....	91							
1.00.....	100							

* Otis, A. S., "Statistical Method in Educational Measurement," p. 225. World Book Company, Yonkers, New York.

From this table it may be seen that in the case of a correlation of .70 there are only 34 chances in 100 that an individual's second score (grade point average in the present case) will be in the same "tenth" † of the distribution as his first score; the chances are 81 in 100 that his second score will not be displaced by more than one "tenth"; there are 97 chances in 100 that the second score will not be displaced by more than two "tenths"; etc.

TABLE 3

ZERO-ORDER AND MULTIPLE CORRELATION COEFFICIENTS BETWEEN FIRST SEMESTER GRADE POINT AVERAGE AND EXPERIMENTAL COMPOSITES *

Variables†	Zero-order r‡	Multiple R§	
6(2345)	.74±.03	.77	
6(234)	.75±.03	.76	
6(245)	.75±.03	.77	
6(45)	.77±.03	.77	
6(24)	.77±.03	.76	$N=99$
6(345)		.76	(Group I)
6(235)		.69	
6(23)		.69	
6(25)		.69	
6(34)		.70	
6(35)		.68	
7(2345)	.68±.04		$N=84$
7(2345)	.71±.04		(Group II)

Variables:
2. High School Content Examination.
3. Iowa Silent Reading Test.
4. Mathematics Aptitude Test.
5. English Training Test.
6. First Semester Grade Point Average.
7. Second Semester Grade Point Average.

* Zero-order correlations are those involving only two variables; first order correlations involve three variables; second order correlations involve four variables; etc.

† The numbers in the parentheses indicate the tests which were used in forming each composite score.

‡ Test scores were combined and treated as a single score.

§ Test scores were treated in a multiple regression equation.

The more specialized nature of engineering college subjects suggested the possibility that a special combination of the tests in the Qualifying Examinations might yield better predictive results than

† A "tenth" here is not a decile but a median deviation distance on the base line of the frequency surface, with the complete normal distribution covering a range of ten median deviations.

the entire battery. To determine the best predictive battery, a number of experimental composite scores were correlated with the criterion (grade point average). These composites were derived by totaling raw scores of various combinations of the tests used, and by the use of the multiple correlation technique with the same combinations.

It is apparent from Table 3 that nearly all the different composite scores yielded closely comparable results. Therefore, if prediction alone were the criterion in test usage, a combination of the Iowa High School Content Test and the Mathematics Aptitude Test of the Iowa Placement Examinations series would be the simplest and most efficient battery. However, the increasing emphasis upon personalized consideration and guidance of the individual student in colleges of engineering suggests the need for reliable information in other scholastic areas as well. The battery in which the Iowa Silent Reading Test and the English Training Test are included not only yields valuable prediction data in the first year, but for subsequent performances as well. And, as instruments for personnel purposes, the evaluation of reading and command of English seem to be regarded as of primary importance by experts in engineering curriculum.

Within five years after entering the College of Engineering a group of twenty-six students had been granted degrees in engineering. By the processes of educational selection, this group was markedly superior in scholastic ability to the original entering group. Concomitant with increased ability as shown in Table 4,

TABLE 4

COMPARATIVE ABILITY AND ACHIEVEMENT LEVELS OF VARIOUS SAMPLES STUDIED

Group	Composite Score		First Year Achievement		
	A.M.	S.D.	A.M.	S.D.	N
I.....	485.1	135.8	2.01	.80	99
II.....	492.8	132.7	2.02	.71	84
III.....	550.6	124.6	2.52	.67	26

A.M. Signifies Arithmetic Mean.
S.D. Signifies Standard Deviation.

this group was also characterized by greater homogeneity as is indicated by the smaller standard deviations on all the ability measures. This reduction in variability normally would be expected to decrease the efficiency of the predictive tests. However, as Table 5

TABLE 5

CORRELATION COEFFICIENTS BETWEEN QUALIFYING EXAMINATION COMPOSITE SCORE AND GRADE POINT AVERAGES OF GRADUATING GROUP

r_{12}	r_{13}	r_{14}	r_{15}	
.87±.03	.79±.05	.83±.04	.76±.06	$N=26$ (Group III)

Variables:
1. Composite—based on the four tests.
2. First Semester Grade Point Average.
3. Second Semester Grade Point Average.
4. First year Grade Point Average.
5. Total College Career Grade Point Average.

reveals, the tests actually increase in predictive efficiency for this special group. The coefficient of .87 for first semester grades represents an improvement of about 50 per cent over "best guess." This predictive power, diminished only slightly over the entire scholastic career period, indicates a valuable validity for detecting superior students in engineering. It is significant to note that of the 26 students who were graduated, none was below the 30th percentile on the ability measures, and only two were below the 40th percentile in ability.

SUMMARY AND CONCLUSIONS

The possibility of selecting promising candidates for engineering training by means of examination techniques was subjected to experimental study, using as subjects the class which entered the College of Engineering of the University of Iowa in 1931. The Iowa Qualifying Examination battery, composed of the Iowa High School Content Test, the Iowa Silent Reading Test, and the English Training and Mathematics Aptitude tests of the Iowa Placement Examination Series were used individually and in combinations as predictive measures. Each test alone yielded satisfactory predictions of first semester and first year achievement, the correlation coefficients ranging from .57 and .72. A composite score, based upon the weighted combination of the four tests correlated .74 ± .03 with first semester grades, and .71 ± .04 with total first year achievement.

Various composite scores were formed, by simple addition, and also by the use of multiple correlation technique. The simple additive composites were found to yield as satisfactory prediction coefficients as the more elaborate statistical treatment. If prediction alone were the goal, the simple combination of the Mathematics Aptitude and English Training tests or the High School Content

and Mathematics Aptitude tests would yield as high predictions as the more elaborate battery. However, for purposes of valid educational guidance, the diagnostic information obtained in the other areas is deemed essential.

There is a progressive upward selection in ability of the students as they progress toward graduation. Of the original 99, the 26 who were graduated were a group of definitely superior ability. Despite this fact the prediction coefficients for this selected group are higher than those obtained for the total sample. No student below the 30th percentile on the ability measures was graduated from this college.

The findings of this study suggest a number of conclusions which have bearing upon the administration of student personnel in the College of Engineering. The predictive efficiency of suitable tests given at the beginning of the freshman year furnishes a reliable basis for the formulation of personnel techniques. Furthermore, they furnish a basis for the elimination of the student lacking in ability early in the educational process at a notable human and economic saving for the student and the university. Naturally, all the entering students present the required high school credits. Therefore, the completion of certain high school subjects becomes an invalid basis for selection. Yet of the 26 students who were graduated, only two were below the 40th percentile in the Qualifying Examinations and neither of these was far below that mark. Such examination standards then furnish a reliable basis for student selection.

Especially noteworthy is the high rate of student mortality as is evidenced by the drop in numbers. Of the 99 who completed the first semester, only 84 completed the first year, and only 26, slightly more than one-fourth, of these remained in the college to graduate. Although all the reasons for this mortality cannot be ascertained, a large portion may be laid to inadequacy of abilities and preparation—an inadequacy which could have been determined before a semester or year of disastrous failure.

The college of engineering shares with the college of medicine the responsibility of training men for public service. Therefore, it must hold up exacting standards of achievement for those to whom it gives its stamp of approval. However, in the interests of sound educational guidance, the college of engineering may well consider methods of reducing its rate of scholastic mortality and directing the efforts of the unfit student into channels which promise greater personal and social growth.

ENGINEERING OCCUPATIONS AFTER GRADUATION *

(Based on a Ten Year Survey of the Graduates of the Sibley School of Mechanical Engineering at Cornell)

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One very often hears the questions asked to-day, "Of what should an engineering education consist?" "What should be the balance between the business and technical subjects, and what should be the content of each of these divisions?" Though it is not the purpose of this paper to answer these questions or to plan a curriculum for an engineering college, some of the information contained herein might well be taken into consideration when planning or changing such a curriculum. The paper gives a summary of the compilation and a discussion of the returns received from the graduate follow-up plan instituted in the Sibley School of Mechanical Engineering at Cornell University in 1928 by Professor John R. Bangs, Jr. Through this follow-up plan, the progress made and the work done by Cornell's mechanical engineering graduates is followed. In the past ten years much interesting and valuable data have been accumulated. From it the School is able to learn the character of the work the graduates go into and the types of industry they enter. In addition, much light is thrown from this information on the changing attributes required by industry in its engineers.

The plan instituted in 1928 provided for a five-year follow-up, but this year it was extended to include the ten-year class, the class of 1928 with which it was started. Each year in January, for five years after Commencement, the graduate receives a letter from the college personnel office asking him for whom he is working and also asking him to describe in some detail the character of the work he is doing. This year the ten-year class was asked for similar information and also for a brief of what they had done in the intervening five years since they had been last contacted. In addition, they were asked to offer any comments they wished to make

* Presented at a Conference on Professional Status and Employment of Engineering Graduates at the 46th Annual Meeting, S. P. E. E., College Station, Texas, June 27–30, 1938.

regarding their education as they viewed it in retrospect aften ten years of experience. This a good many did with pleasure, one man writing six pages and another one eight.

The response to the follow-up questionnaire letters has been, on the average, very good, and sufficient returns have now been made to make information submitted fairly significant. Nearly all of the men report at one time or another during the five-year follow-up and about 25 to 30 per cent report regularly each year. The first year after graduation between 80 and 90 per cent of the men generally reply. In succeeding years, the response drops to a low, usually in the fourth year, when between a 50 and 60 per cent return is obtained. This year slightly better than a 50 per cent return was received from the ten-year follow-up letter to the class of 1928. These percentages were not maintained by the classes of 1931 and 1932. Undoubtedly a good many men in these classes found it difficult, if not impossible, to obtain employment, especially employment in work for which they had been trained. Apparently reticent to report no work, or else thinking that their report would be of no significance if they were not in engineering work, a larger percentage of men than usual failed to reply. Whatever the cause, the return was much poorer, especially for the class of 1932 for which only a 70 per cent return was received the first year. The second year it remained at about 70 per cent after which it dropped into the fifties for the third, fourth, and fifth years.

The information received from this follow-up of the engineering graduates has been analyzed in two ways in this paper. First, and perhaps the more valuable, is an analysis as to the character of the work the graduates do, whether it is design work, accounting, industrial engineering, sales, etc.; and secondly, it has been analyzed as to the type of industry Cornell supplies with men. This latter classification will vary to some extent with schools from section to section in the country as their proximity to one or another industry varies. The classification as to the character of work done within business and industry, however, should be fairly typical of that in any section of the country, the basic functions in industry being not much influenced by geographical location.

Classification as to the Character of Work Done

Table I shows the classification as to the character of the work being done by Cornell's mechanical engineering graduates which was used in the first analysis of the information. It also shows all of the data which has been obtained on the class of 1928, a representative class, on which ten years of information is now on hand.

In this classification the division "Training" refers to the formal training courses conducted by industry where men move from department to department every few months. Naturally, the first year or two can be considered as a training period for all graduates, but this division separates those who go into organized training courses from those who obtain their training in some one department. The other divisions are very largely self-explanatory with the exception, perhaps, of the division "Supervisory." Under "Supervisory" were grouped those men who were in positions of foremen, gang bosses, and a few miscellaneous men in management positions who could not be definitely allocated to some other division.

TABLE I

CHARACTER OF THE WORK DONE BY THE CLASS OF 1928 FOR THE FIRST TEN YEARS AFTER GRADUATION

	1	2	3	4	5	6	7	8	9	10
Training	22	6	1	0	0	0	0	0	0	0
Graduate Work	3	0	2	1	3	2	0	0	0	0
Teaching	2	3	1	3	2	3	3	2	2	1
Drafting	4	2	0	0	0	0	0	1	1	1
Design	6	9	4	0	1	3	3	5	5	4
Development	5	5	4	4	2	4	4	3	3	3
Research	1	0	0	1	1	0	0	0	0	0
Labor	0	0	0	0	0	0	1	0	0	0
Inspection and Test	0	0	1	0	2	0	0	0	0	0
Maintenance	4	2	1	0	0	0	0	0	0	0
Production	2	3	5	4	6	5	5	4	4	4
Supervisory	0	2	2	0	0	4	4	3	3	4
Industrial Engineering	5	6	2	0	1	0	0	0	1	0
Enginering Planning	2	2	4	5	4	1	1	0	0	0
Accounting	1	0	0	1	2	0	0	0	0	1
Factory Cost and Appraisal	8	4	3	4	6	1	1	1	1	1
Sales	5	9	8	10	12	10	11	13	12	13
Customer Service	1	1	0	1	0	0	0	0	0	0
Purchasing	0	0	0	0	2	0	0	1	1	1
Personnel	0	0	1	0	0	0	1	1	1	1
Patent Searching	1	0	0	2	3	2	2	2	2	2
Miscellaneous	1	2	1	2	3	2	1	1	1	1
Total	72	54	39	36	45	37	37	37	37	37

Table I shows a characteristic decrease with each succeeding year in the number of men who are in organized training courses and also a characteristic increase in the number in sales work. The decrease in the total number of men reporting each year influences to some extent the rate of these changes, making the decreases more pronounced and the increases less pronounced in this table than they actually are. The small number of men reporting in design in the fourth and fifth years is not typical of other classes. It may be partially accounted for either by the depression, the four and five year reports for this class falling in 1932 and 1933, or, as is more likely, by a disinclination on the part of those doing design work to return the questionnaire letters in these years.

This table and the combing of the ten-year information shows that the graduates are fairly well settled, both as to company and as to the type of work they do, in four or five years after graduation. There are, of course, some men who never settle down, but apparently, under normal conditions, the majority of men make few changes, outside of advancements within a given company, after four or five years in industry. If this is true, then Table II becomes of significance. This table shows the number of men from each of six classes, 1928 to 1933, falling into each classification of work after five years. The number in sales work at the end of five years is consistently high, and the total of 56 out of the 279 who reported is nearly twice the number of men in production work which claims 29 men, the second largest number. Engineering design follows production closely with a total of 26 men. It is interesting to note, though, the large number of men in cost work—Accounting, and Factory Cost and Appraisal. Forty men are doing work in these two fields, work for which they receive very little if any specific training in college.

But how does the engineering graduate get into these lines of work, directly or through some intermediate training or "stepping stone" as it were? Table III throws some light on this question. It shows the percentage of the total number of men who have reported in the last ten years, classified as to the type of work they were doing in the first, second, third, fourth, and fifth years after graduation. The lines of work which show a decreasing percentage of men each succeeding year may be considered as the "stepping stones." They are the methods used by industry primarily to train its men. The lines of work with increasing percentages are those for which a specific training period in some other line of work is essential or advisable. The lines of work which employ an essentially constant number of men from the first year on, may be considered as lines for which the graduate is fitted for upon graduation,

and which are not used primarily to train men for other lines of work.

TABLE II

CHARACTER OF THE WORK DONE BY THE CLASSES FROM 1928 TO 1933 AT THE END OF FIVE YEARS AFTER GRADUATION

Class of ... Year Reported ...	'28 '33	'28 '34	'30 '35	'31 '36	'32 '37	'33 '38	Total	Per Cent
Training	0	0	0	0	1	1	2	0.7
Graduate Work	3	0	0	0	0	0	3	1.1
Teaching	2	2	0	2	1	1	8	3.0
Drafting	0	1	1	1	0	0	3	1.1
Design	1	1	5	5	6	8	26	9.8
Development	2	2	2	3	2	3	14	5.2
Research	1	1	0	2	0	2	6	2.2
Labor	0	0	0	0	0	1	1	0.4
Inspection and Test	2	2	1	0	1	1	7	2.6
Maintenance	0	0	5	1	7	1	14	5.2
Production	6	6	4	2	8	3	29	10.9
Supervisory	0	1	2	1	5	2	11	4.1
Industrial Engineering	1	3	5	1	3	4	17	6.3
Engineering Planning	4	2	0	0	4	0	10	3.7
Accounting	2	6	2	6	2	1	19	7.1
Factory Cost and Appraisal	6	5	1	2	4	3	21	7.8
Sales	12	8	8	10	11	7	56	21.0
Customer Service	0	0	2	1	0	0	3	1.1
Purchasing	2	0	0	0	2	0	4	1.5
Personnel	0	2	1	0	1	0	4	1.5
Patent Searching	3	1	2	0	1	3	10	3.7
Miscellaneous	3	4	4	2	7	1	—	—
Total							268	100.0

The most prominent training device is, of course, the training course which is used to acquaint nearly 30 per cent of our college graduates with industry. Normally, these last a maximum of two or three years. Therefore, those who are in training courses in the fourth and fifth years after graduation are men who have either taken graduate work in college or who have made some change in company and hence are starting on the same level with the first year graduate. From the training courses the men sift into almost every other line of work. Drafting, another obvious training de-

vice, is used quite largely to fit the graduate for positions in design and development work. Labor, inspection and test, and maintenance are all used to some extent to train men for production work, although they are also quite largely used to train for design and

TABLE III

PERCENTAGE CLASSIFICATION OF THE CLASSES OF 1928 TO 1936 AS TO THE CHARACTER OF THE WORK DONE FOR EACH OF THE FIRST FIVE YEARS AFTER GRADUATION

Year after Graduation	1	2	3	4	5
Classes Include	'28–'36	'28–'36	'28–'35	'28–'34	'28–'33
Total Number in these Classes	770	770	667	568	487
Number Reporting	607	484	362	281	268
Percentage Reporting	79%	63%	54%	49%	55%
Training	29.2	12.0	3.9	1.8	0.7
Graduate Work	11.1	7.0	3.9	2.1	1.1
Teaching	2.8	3.5	3.9	5.0	3.0
Drafting	4.0	3.1	2.5	2.1	1.1
Design	6.4	8.9	12.1	10.1	9.8
Development	4.8	6.0	7.2	8.3	5.2
Research	1.5	0.8	0.8	2.5	2.2
Labor	3.3	1.8	0.6	0.0	0.4
Inspection and Test	3.0	2.9	3.0	3.2	2.6
Maintenance	3.0	4.1	3.9	2.1	5.2
Production	6.3	7.7	10.5	11.1	10.9
Supervisory	1.7	3.5	3.6	3.2	4.1
Industrial Engineering	4.3	8.5	6.9	7.1	6.3
Engineering Planning	0.8	2.1	2.7	3.2	3.7
Accounting	5.9	4.8	5.0	5.8	7.1
Factory Cost and Appraisal	2.8	4.1	4.1	6.1	7.8
Sales	7.2	15.7	20.4	20.6	21.0
Customer Service	1.0	1.7	2.7	2.1	1.1
Purchasing	0.2	0.4	0.6	0.4	1.5
Personnel	0.5	0.8	1.1	1.4	1.5
Patent Searching	0.3	0.6	0.6	1.8	3.7

development work and, to some extent, work in engineering planning. Sales consistently absorbs the largest number of the engineering college graduates, roughly 20 per cent after the first three years. It draws men from all of the other departments. However,

training courses, design and development work, and, to a lesser extent, inspection and test work are the primary training devices for sales work.

The depression had its influence upon this more or less normal method of inducting college graduates into industry, as it did upon everything else. It caused the number of men in laboring positions, and in maintenance and repair work to increase markedly during the years from 1931 to 1934. The number of men starting in training courses decreased just as markedly to a low with the class of 1932. The first year returns for the class of 1932 showed only about half of the normal number of graduates in training courses while nearly four times the normal number returned to college for graduate work. This was the only class that showed an increase in the number in training courses in the second year, the number jumping from 12 to 16, where the normal decrease is roughly that shown for the class of 1928 in Table I, from 22 to 6. The class of 1933 was apparently a little more successful in finding positions than was the class of 1932, though a good many more started in laboring positions the first year. The class of 1934, whose first report was made in January of 1935, was apparently almost back to what might be considered normal.

It is interesting to note from Table III that after five years only a relatively small percentage, from 15 to 20 per cent of the graduates, are in research, development, design, and drafting work. These are the pursuits around which engineering curriculums were largely built in the latter part of the nineteenth century when engineering curriculums were taking form. On the other hand, better than 20 per cent are in work directly connected with selling alone. The importance of this phase of engineering work is just coming to be recognized and to receive the attention in our engineering schools warranted by its importance. Accounting, cost accounting, appraisal work and problems in engineering economics are other phases of engineering work which our graduates are becoming more intimately concerned with. These also have not received until the last few years, and in many instances are not receiving to-day, the stress due them in our engineering curriculums.

True, the fundamentals of engineering constantly run through all of these lines of work, and they cannot be neglected; but should specialization in technical pursuits be advised when such a small percentage of the graduates later follow them closely? Along this line, one of the men of the class of 1928, now in customer service work, in response to the ten-year survey writes: "While I happen to have followed very closely the line of work I studied at Cornell, I am now of the opinion that it is more advantageous for the student of mechanical engineering to take a course less specific than

the one I studied. Your survey will show it, but my guess would be that very few of us necessarily benefit by specializing in our senior year." And another graduate, this one in design work, writes, "I look back to Cornell with greater respect every year. I am glad to see that it is changing. Back in 1928 we were only interested in ourselves. To-day we and, I believe, more of the students are interested in others. We are concerned with the effect of machines on humans. As I recall, we were only concerned with mechanical stresses, mathematics, and banker's economics when I was in school." He later says, "My one regret in looking back at the college days is my devotion to formulas and mathematics. I wish that I had realized that professors were humans, that is, most of them."

In view of these facts, and these and other sentiments expressed by graduates, would it not be advisable perhaps to give the student at least a fundamental course in marketing, and some economics and accounting rather than cramming specialization down his throat, especially when there is only a slim chance that he will ever use it? In some cases where the student knows definitely what he is going to do, specialization is undoubtedly a good thing; but how many students have their futures planned to such an extent?

Classification as to Industry

Table IV shows the number of men in the classes from 1928 to 1933 who were working in various industries and occupations at the end of five years; and Table V shows the total number of man-years which each class spent in these industries and occupations in the first five years out of college. Manufacturers of industrial and other large equipment—turbines, motors, generators, machine tools, hoists, and the like—employ by far the greatest number of the graduates from Cornell, while utilities companies employ the second largest number. Manufacturers of materials—textile, rubber, glass, paper, and similar products; the manufacturers of air-conditioning, refrigeration and power-plant equipment; and the manufacturers of metal products—wire, tubing, sheet metal, aluminum and the like—also employ a large number of Cornell graduates.

Though they are few in number, it is interesting to see the diversified lines of work into which the men go who do not follow directly in engineering pursuits. Quite a number of men, a few from nearly every class, have gone into various phases of insurance, from the selling of life and automobile insurance to insurance work in connection with safety inspections of industrial equipment and conditions. Quite a few men have gone into financial organizations, and one or two nearly every year go into law, if not the

TABLE IV

CLASSIFICATION OF GRADUATES AS TO INDUSTRY OR OCCUPATION FIVE YEARS AFTER GRADUATION

Class of	1928	1929	1930	1931	1932	1933
Year Reported	1933	1934	1935	1936	1937	1938
Number in Class	74	87	67	89	101	69
Number Reporting	45	51	40	43	55	36
Utility	3	7	3	4	6	1
Manufacturing Large Equipment	10	7	5	8	8	7
Manufacturing Small Equipment	3	3	3	3	4	3
Manufacture of Materials	1	3	3	5	6	5
Metal Products	3	5	5	3	1	2
Oil Industry	0	2	4	2	6	2
Aviation	0	3	2	3	1	0
Automotive	1	0	2	1	1	1
Railroads	1	1	2	0	0	1
Communication	3	0	2	1	0	0
Chemical Industry	1	2	0	3	5	1
Refrigeration and Air Conditioning	2	3	5	2	4	4
Building Construction	1	0	0	0	1	0
Ship Construction	1	0	0	1	2	1
Selling Organization	4	1	0	1	2	2
Finance and Insurance	2	6	1	2	4	0
Law	1	1	2	0	1	4
Teaching	3	3	0	3	1	1
Graduate Work	4	0	0	0	0	0
Government	0	4	1	1	2	1
Food	1	0	0	0	0	0

practicing of general law, then into patent law and patent examining. The men who have gone into work in law have invariably taken graduate work in some law school. Surveying, publication editing, government work—C.C.C., W.P.A., and Soil Conservation Work—dentistry, medicine, and funeral directing are all professions into which Cornell's trained engineers have gone in the last 10 years.

One more rather interesting bit of information from this survey is shown in Table VI. This table shows the number of changes in companies made by the men in each of the classes from 1928 to 1933 during the first five-year period after graduation. This table is based only on those men who reported a sufficient number of times to make their records reliable from this standpoint. In reasonably good times, represented by the classes of 1928 and 1929, roughly 60 per cent of those reporting sufficient information made no changes in company in a five-year period. In the more difficult times, experienced by the classes from 1931 to 1933, between 40 and

TABLE V

TOTAL NUMBER OF MAN-YEARS REPORTED IN EACH INDUSTRY OR OCCUPATION DURING THE FIRST FIVE YEARS AFTER GRADUATION

Class of	1928	1929	1930	1931	1932	1933	Total	Per Cent of Total
Utility	21	49	15	27	32	9	153	10.1
Manufacturing Large Equipment	68	49	32	51	39	42	281	18.7
Manufacturing Small Equipment	15	11	8	14	11	23	82	5.4
Manufacture of Materials	8	34	14	21	34	23	134	8.9
Metal Products	15	30	23	20	5	9	102	6.7
Oil Industry	0	9	10	13	32	15	79	5.2
Aviation	2	10	4	12	8	2	38	2.5
Automotive	4	3	9	10	8	11	45	3.0
Railroads	5	5	8	1	0	1	20	1.3
Communication	20	0	20	6	1	0	47	3.1
Chemical Industry	5	11	2	14	26	10	68	4.5
Refrigeration and Air Conditioning	18	20	26	25	17	19	125	8.3
Building Construction	7	0	3	4	6	0	20	1.3
Ship Construction	8	0	2	6	10	5	31	2.1
Selling Organization	12	3	0	11	12	8	46	3.0
Finance and Insurance	4	15	5	10	16	1	51	3.4
Law	2	1	9	0	7	10	29	1.9
Teaching	12	12	6	17	7	6	60	4.0
Graduate Work	10	13	16	12	21	5	77	5.1
Government	0	4	3	4	4	2	17	1.1
Food	5	0	0	0	0	1	6	0.4
Total	241	289	215	278	296	202	1511	100.0

TABLE VI

THE NUMBER OF CHANGES IN COMPANY MADE BY THE MEN IN THE CLASSES OF 1928 TO 1933 IN THE FIRST FIVE-YEAR PERIOD AFTER GRADUATION

Class of	Number in Class	Adequate Data on	Number of Changes in Company				
			None	1	2	3	4
1928	74	44	28	6	6	4	0
1929	87	33	20	7	4	2	0
1930	67	25	16	5	4	0	0
1931	89	35	14	8	7	5	1
1932	101	47	19	16	5	6	1
1933	69	34	17	11	3	3	0

50 per cent made no changes in company while the number making only one change jumped considerably.

Comments of Ten-year Graduates on Their Education

The comments which the graduates of the class of 1928 made in reflecting on their engineering education in answer to the questionnaire letter this year are both interesting and instructive. Some of the men were not satisfied to offer only a few comments but wrote extended and helpful discussions of their experiences as they had been colored by their education. None of the comments offered were critical of the education but many offered constructive suggestions for improving the comprehensiveness of the education they had received. Some of the remarks are of a general nature, but are, nevertheless, valuable; others suggest specific fields which should be covered in an engineering curriculum. Typical of the more general remarks is the following from a man in "harbor development, road construction, waterworks construction," and similar lines of work. He writes:

"During the last few years, I've been drifting away from the engineering details of our work and getting further involved in the management end. Notwithstanding, however, there is a continual demand upon the engineering fundamentals in making every-day decisions.

"As a matter of fact, my strongest opinion in the matter of engineering education concerns itself with the fundamentals that were taught us in our first two years. I believe that the most valuable subjects thrown at us were those which most nearly approached pure science. Such subjects as Calculus, Physics, Chemistry, Mechanics, Kinematics, Heat-Power and Basic Electricity all sort of sink into your consciousness and become part of you when the more detailed subjects are forgotten.

"If I were doing it all over again, I would concentrate on the fundamental sciences and let the specialist studies go by the board. Unless a lad has a pretty good idea of what he is going to do after graduation, and most have no idea at all, he is apt to gather a lot of dunnage in his head when he might be improving the broad foundation of his learning with more fundamentals.

"Aside from the technical phase of an engineer's education, let me add one more wail to the old theme that we didn't get enough so called Classical subjects. You should place anyone in jail who graduates with an M.E. degree and doesn't know any more about economics, philosophy, history, languages, etc., than I did when I got out."

Of the specific fields which the graduates feel should be more

adequately treated in an engineering course, marketing and cost estimating are most often suggested; to a lesser extent, English, economics, law, and psychology are mentioned. Representative of these remarks are the following:

An Air-Conditioning Design Engineer: "In addition to what I took in the Industrial Option, I feel that selling and psychology could be added to advantage."

A Sales Engineer: "It might be well to consider, if you do not already have one, a course for engineers in marketing and distribution. I think that problem is the important one of the future."

A Production Manager: "An understanding of costs and the placing of the product on the market are of great benefit."

A Vice-President and Personnel Manager: "I would suggest adding a course in estimating costs of production and the various factors involved."

A Salesman: "From my point of view, I would prefer to have had more economics and some law, and less drafting and shop work."

A Commercial Engineer: "We still lack engineers who can write the English language."

A Production Superintendent: "Teach the students the technique of skillfully using the English language."

So it is seen that the responsibilities of the engineering graduate are continually changing and expanding, and it is the duty of the engineering school to keep up with and train men to meet these expanding responsibilities. Surveys and follow-up plans such as the one discussed herein help much to keep the school in touch with these changing requirements of industry.

Discussion

By ROBERT L. CARRUTHERS

Sun Oil Co.

Mr. White's paper represents a vast amount of work both in the accumulation of data and in the analysis of the assembled facts. The information presented might well be considered when planning or changing an engineering curriculum. The work is fundamental and of the same fine quality as that done by this society throughout the years since its inception in 1892.

The comments of the engineering graduate indicate an almost universal need for a better command of the English language. Our experience with young engineers is that those who write clear, concise letters and reports invariably forge ahead of those who do not. Several engineering graduates have expressed the opinion

that they should have studied more "engineering English" and less "classical literature." One graduate said, "The English courses should be less idealistic and more practical." Another said, "We need more courses in better speech and in report writing." Almost anyone would agree with J. A. L. Waddell, when he said, "Possessing a mastery of the English language, the engineer may or may not rise to eminence; but without it, he certainly cannot."

One survey, extending over a twenty year period, made by an Eastern university for the class of 1900, showed that only ten per cent of graduates were following the course studied and that a much larger per cent were in executive positions of one kind or another.

It has been said that an executive's life might be divided into three stages: Ten years of wondering, ten years of blundering, and ten years of thundering. Some systematic study over a period of years would certainly reduce the damage done and possibly the agony suffered during the periods of wondering and blundering. The executive needs some knowledge of law, accounting and finance, as well as a thorough knowledge of the particular business in which he is engaged. He needs a knowledge of law sufficient to enable him to see a red flag some considerable distance down the road; at least enough law to know when to consult a lawyer. He needs enough knowledge of accounting to be able to analyze a financial statement thoroughly and intelligently. He needs enough knowledge of finance to know the value of a dollar or a property to-day, to-morrow and ten years from now.

How many engineering graduates who are doing work that could be classified as production, supervision, or sales—who might be considered potential executives—neither realize their great need for the broad principles of law, nor know what steps to take to become familiar with these principles? How many graduates know that in Texas, for instance, the Supreme Court has set out what it believes to be a complete and well-rounded course of legal study, and that the books prescribed are intelligible to an engineer?

How many of the engineering graduates who are doing work that could be classified as accounting, factory costs, and appraisals —who also might be considered potential executives—neither realize their great need for a knowledge of the broad principles of accounting, nor know what steps to take to become familiar with them? How many graduates know that in Texas, for instance, the State Board of Public Accountancy has set up what it believes is a complete and well-rounded course of study for the certified Public Accountant?

How many engineering graduates have any conception of the

subjects studied or the training received by the student of finance? Every industry, especially the oil industry as it operates is confronted with problems in finance that vitally affect engineering planning. Every executive must and every engineer should have some knowledge of finance.

It is quite evident from the facts presented in Mr. White's paper that the responsibilities of the engineering graduate are continually changing and expanding. The task of training men in four or five short years to meet these expanding responsibilities is a difficult one, especially is this true since neither the college nor the student has any definite knowledge of what these responsibilities will be.

William B. Bizzell once stated a truth which was startling to the undergraduate mind: "You will forget all you have learned here in college." This being true, would not benefits result from a closer contact between college and student after graduation? After all, should the duty of the engineering school (as stated by Mr. White) to keep up with and train men to meet these expanding responsibilities be considered totally and completely discharged at the time of graduation?

One outstanding Virginia woman's college has this year instituted a plan that promotes a closer contact between school and graduate. All members of the Alumnae Association received a folder which stated, "A cordial invitation—to return to Randolph-Macon to the Alumnae College is extended to all alumnae and former students, their husbands, families and friends." A five-day program following immediately after commencement consisted of fifteen lectures, three teas, one religious service and morning prayers. A play, golf, riding, and the Tiny Tots Work Shop for the children offered further inducement.

Could not the engineering school be expected to advise the student while he is in college through a system of lectures, or at a later date by other means, that the college is willing and prepared to assist him in continuing his education? This might consist, merely, of suggesting subjects, the study of which has proved beneficial to those working in certain occupation or industries. A list of books might supplement this, each title being followed by comments as to its scope and an indication of good and bad points.

Much thought and effort might be devoted to the ways and means of bringing about a closer contact between the educational center and the man in industry. It would be interesting, indeed, to know the results of some such plan.

RESEARCH IN RELATION TO TEACHING*

By HARMER E. DAVIS

Assistant Professor of Civil Engineering, University of California

The topic for this afternoon's session, relating to problems of the young instructor, seems to be particularly appropriate for discussion before this society. I hope that at least there may be read into the records of the society what some of the problems are, and that exchange of ideas on this subject may be of benefit to those of us directly concerned.

I would roughly classify the problems of the young instructor into two general groups: those pertaining to teaching methods, and those pertaining to choice of attitude or of viewpoint. Problems of the first group are not those of the young instructor alone; they continuously receive the attention of this society and they frequently constitute the "shop talk" when educator meets educator; we shall not try to solve them here.

Problems of the second sort relate to the direction of effort, rather than the technique of doing. They pertain particularly to the young instructor and may influence his adoption of teaching permanently as a profession. Certainly the solution of such problems affects his satisfaction with his work and probably his promotion. I propose to offer a few comments on one phase of this subject, namely, the relation of research to teaching.

Common questions faced by the young instructor are, "Shall full time be devoted to matters relating directly to teaching, or should some attention and effort be devoted to research or to practical work outside the college?" and, if a decision is made to engage in some activity in addition to teaching, "What factors should be considered in making a choice of activity?" Admittedly, there are those who are qualified to become excellent and successful instructors by devotion of effort to teaching alone. However, there is a large group of those who believe that the successful teaching of engineering subjects requires at least some background of engineering experience. For those who feel this way, some effort toward attainment in the engineering profession is necessary to preserve a sense of balance and a sense of progress. I refer particularly to the latter group.

* Presented at the Civil Engineering Division at the 46th Annual Meeting, S. P. E. E., College Station, Texas, June 27–30, 1938.

The choice of a particular line of activity appears to be a matter of personal inclination, aptitude, and—to some extent—opportunity. A dual purpose is involved: personal development, and the laying of a basis for proficiency in some branch of engineering whether the effort be expended in the field, the shop, the office, or the laboratory.

To my mind, regardless of the activity the common factor which should be involved is an attitude of inquiry, of investigation—the research attitude. From this point of view research is a broad thing. It does not necessarily conflict with the idea of practical experience, for certainly some of the most successful of practical men have been those of imagination and inquiring mind.

The idea of research has, of course, been most commonly associated with experimental work in the laboratory although historical matters, mathematics, and even methods and processes are not infrequently recognized as subjects for research. Where the young civil engineering instructor is concerned, perhaps the most accessible field of research is the physical testing laboratory. Particularly in experimental work, I believe it important that there be a positive realization of the significance and the philosophy of scientific research.

To me the undertaking of an investigation has a certain element of excitement in it. It might be compared, say, with the planning of a military campaign. The following questions seem worthy of consideration: What are the objectives? How much reconnaissance is necessary? What forces can be mustered? Can the forces be reduced without weakening the attack? What tactics should be employed in the various situations that will probably be encountered? What are the relative merits of several optional plans of attack? What methods has past experience indicated should be avoided? Answers to questions such as these should almost guarantee a healthy interest in a project for its own sake. On the other hand, certainly nothing could be more disastrous to real development than the patent-medicine taker's unenquiring attitude.

Insofar as laboratory research has to do with providing the young instructor with a better background for teaching, some of the general advantages and disadvantages may be listed as follows:

Advantages

1. It provides a ready source of new and personally experienced illustrations for use in teaching.

2. It acts to emphasize the limitations imposed by the assumptions employed in common mathematical analyses.

3. It can serve to keep a freshness or resilience in general attitude.

4. It provides that from which a sense of accomplishment may be derived.

5. It provides material for inductive analysis.

6. It provides material for reports and publications.

Disadvantages

1. The time required may prove detrimental to successful teaching.

2. Practical solutions to problems are not always emphasized.

3. Ordinarily no training is provided in meeting rigorous cost and time limitations.

4. There is often no definite incentive to economic procedures.

5. Usually there is no check on efficiency of methods by adverse criticism of competitors.

As a matter of personal development, the instructor would naturally try to overcome these disadvantages.

The foregoing remarks have dealt mainly with the relation of research to the personal development of the instructor. However, no discussion of the general topic would be complete without at least brief mention of research in relation to the student. This relation is commonly secured through problems or investigations having to do with the thesis.

Although in some quarters in recent years the undergraduate thesis has fallen into disrepute, I believe that the thesis has an intrinsic worth entirely distinct from the fact that it has had a time-honored place in the usual curriculum. I will say that it has taken me a few years to recognize its potentialities. A few remarks summing up my own reactions may illustrate this point.

With large classes and crowded curricula, which are becoming the rule rather than the exception in many engineering schools, instruction has grown more and more formalized. There exists, then, a definite need for some instruction on an entirely informal basis. The thesis can meet this need, but in order to make instruction in work relating to the thesis truly effective, I think it is desirable that the instructor recognize the essential difference between this and all other courses which the undergraduate takes.

Because the student's approach to thesis work differs from that in all other courses in his experience, he needs an introduction to it. He needs to develop an understanding of its opportunities. He needs to have instilled in him enthusiasm and perspective for the work. The few minutes necessary to do this in each individual case are well worth while. It may be pointed out, for ex-

ample, that here for the first time is a course in which the student is to a considerable extent on his own responsibility; that what he will accomplish in the way of personal development may in large measure depend upon himself rather than upon the topic, the materials with which he has to work, or the technical instruction he receives. The project may be compared with a job assignment. The meaning of the problem must be understood. Something must be accomplished even though the answer may be negative. The work to be effective should ordinarily be carefully planned, although there should be flexibility in the plans. The work is completed only when the findings are communicated in intelligible form.

I believe that the instructor should never forget that the purpose of a thesis course is primarily to develop the student—not to provide a means of gathering data. Admittedly, with some able and understanding students information of considerable value can be obtained. However, the background for investigational work is almost entirely lacking in the ordinary student. Some students have never learned to work with their hands; many have never taken opportunity to devote independent thought to problems of a general nature. It is only by careful guidance that some students can get any results at all. Success should be measured by the development of the student rather than by the facts obtained or analyses made. The young instructor may just as well realize these things at the start.

The problem assigned should obviously be adapted to the needs and capabilities of the student. It is necessary, therefore, for the instructor to estimate his abilities. It is highly desirable to offer a selection of topics and to take into consideration topics which the student himself may suggest. To do enthusiastic work the student must be "sold" on his subject. If the instructor is carrying on investigations of his own, there is ordinarily no difficulty in compiling a list of topics suitable for thesis projects.

The organization of the student work may require special consideration in certain cases. In the Engineering Materials Laboratory at the University of California we have sometimes found it feasible to extend the scope of thesis work, both in breadth of subject matter and in time, considerably beyond that possible with the usual two-man party. In one instance successful work has been accomplished with as many as fourteen students working on the same project. They worked in sub-groups of two men each, each sub-group having had a definite part to perform. They selected their own chairman, and each man's pride in his end of the work acted as a disciplining power. Periodic meetings of entire groups for report on progress, and ready availability of the instructor or a staff assistant, are important requisites to smooth operation. Con-

tinuity in time is obtained by enlisting the aid of interested junior students who act as apprentices to the senior students and who take over the responsibility of the work the following year.

In all thesis work, it is important that the instructor be able to exert a strong, guiding hand which is not too apparent to the student. The student must make decisions on his own responsibility, and yet he must not be permitted to go too far astray. A rather delicate balance must be maintained. There are no rules to guide the young instructor here, but certainly there is opportunity to apply the principles of research and of teaching to the conduct of thesis work.

PROBLEMS OF THE YOUNG CIVIL ENGINEERING INSTRUCTOR*

By A. W. HUTCHISON, JR.

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The Situation

Thirty years ago, in his criticism of American colleges, Flexner pointed out that one of the chief defects in higher education was that the same faculty served both undergraduate and graduate students. To-day this view still obtains in many quarters. In the single faculty, an instructor must face both directions at once. He is at one hour a teacher of freshmen, in the next, he is the director of research students. The requirements of the two are not the same.

The progress of science seems to have resulted from the accumulation of data and research. Therefore it is concluded, more research means more progress. With research in its proper place, there is no quarrel. However, it is but a short step from research at a graduate level to vocationalism at an undergraduate level. Then instead of a cultivation of the intellect the educational program becomes a detailed study of industrial techniques.

An engineering curriculum in its four year form is a combination of liberal arts college, a professional school, and a trade school. Even with the quasi-rigidity of its curriculum its aims are not sufficiently clear to the administration, the instructor or the student. As is pointed out in the recent Carnegie Report there is a definite failure to place before the instructor a complete objective. There is a lack of continuity in the course broken up as it is into subjects, departments, semesters, units, and credits. To add to the confusion only about fifty per cent of the students graduating in engineering eventually follow this line of work. In such an atmosphere the young instructor is, with no instruction in the art of teaching, given a text book and turned loose upon a class for a semester or so. The fault, if wrong, is not his. Perhaps it is the administration, the system, or the social order. It has often been said that the educational program is a vicious cycle which cannot rise much above the people or the people much above the program.

* Presented at the Conference of the Civil Engineering Division, at the 46th Annual Meeting, S. P. E. E., June 27–30, 1938, College Station, Texas.

The Background of the Young Instructor

Among the qualities generally felt desirable in an instructor are moral character, intellectual ability, adequate training, skill in teaching, sympathy with youth, and experience in teaching and non-teaching activities.

Of the total teaching force in engineering schools, instructors constitute about one-third and carry slightly over one-third of the total teaching load. According to the Report of the Investigation of Engineering Education, 1923–29, engineering schools draw their instructors from the following sources:

From the same institutions, 29 per cent. 23.1 direct from graduating class.
From other institutions, 30.5 per cent. 12.1 direct from graduating class.
From practice, 34.5 per cent.
From other sources, 6 per cent.

The annual losses of instructors total 18.4 per cent with 5.4 per cent going to other educational institutions.

In recent years there has been a decided growth in the attractiveness of teaching as a profession. As a result colleges have found it considerably easier to engage the higher type young men as instructors. Unfortunately, far too many still go into teaching from negative rather than from positive reasons.

Duties of the Young Instructor

The average instructor carries 18.4 clock hours per week. The distribution of this is slightly greater in freshman and sophomore work and particularly in drawing, shop, and laboratory work. He also carries about 2 hours per week of junior and senior lecture and recitation. The average load of all engineering teachers, excluding deans, is 18 hours per week. To the instructor's nominal load must be added time for preparation for classes, planning problems, projects, and experiments, maintenance and operation of laboratories, correction of problems, reports and examinations, conferences and committee assignments. The assigned hours of the instructor come at irregular intervals in the morning and afternoon and result in an unprofitable breaking up of his free time. Comparatively he is not overloaded except that his preparation often takes more time than it would an experienced teacher.

Problems of the Young Instructor

The first concern of the young instructor is to be a normal human being and a good citizen. He should keep in intimate touch with life and have a clear understanding of industrial, social and political affairs. He should be interested in the aims of a total educational program and concerned with the personal welfare of each student.

In the main it is easy for the instructor to dispose of such intellectual challenge as is offered by his students. In his own small field he frequently becomes superior to his associates and his complacency is rarely disturbed with their ideas. His contacts with business and industry are too casual to be of importance. In a word, he is likely to withdraw from the interest and contacts of a world he is preparing students to enter, and become fixed in his ideas and routine in his teaching. In teaching there is an irresistable tendency towards crystallization. The field of engineering is constantly undergoing revision and unless the instructor receives occasional stimulation he may actually become a menace to the intellectual health of the student.

It has long been the custom to look upon scholars as self sacrificing servants whose wants are so few that they might easily be supplied by the most modest of salaries. It is thought that the salaries, which range from $1,000 to $2,500, are adequate, providing the length of service at this level is not too long and salary expectation in the upper bracket is sufficiently attractive.

Instructors, partly from personal ambition and partly from a sense of professional loyalty, are constantly endeavoring to improve both themselves and the service they render. The excellence of an instructor is in general judged by a number of factors: (1) degrees, (2) experience, (3) books and monographs, (4) scholarly articles, (5) membership in learned societies, (6) attendance at meetings and participation in the program of learned societies. Due to the facility with which it can be used the degree is too often taken as a mark of educational quality. Experience is valuable only when it induces an individual to develop improved methods. Publications have become widely accepted evidences of intellectual alertness, however, the comparative worth of a publication cannot be ascertained from its title or length. Haggerty in his "Evaluation of Higher Institutions" concludes that the most valuable items in evaluating the effectiveness of a teacher are the number of scholarly articles published, and attendance at meetings of learned societies. Possibly the reason why this combination stands out as a measure of excellence lies in the fact that both are evidence of continued intellectual alertness. Degrees and experience fre-

quently indicate what a teacher formerly accomplished rather than what he is accomplishing now. To estimate a teacher by the size of his bibliography rather than his influence upon the students is a decided mistake. There has been for some time considerable criticism of the overemphasis on research and publication. A man intensely interested in his own research may begrudge the time and effort he must give to his students. The difficulty comes in deciding what the influence of the teacher upon the student is. To a certain extent this may be done by an analysis of examinations written by his students and the concept of the instructor regarding student accomplishment. Occasional visits to his classes, if a part of the regular routine, may be of help. Examination of his course outline and syllabi of lectures will be of value in determining his effectiveness.

Many instructors in schools devoted to vocationalism are selected and promoted not because of their intellectual capacity but because of their practical experience. In such a place the instructor must necessarily feel a certain sense of inferiority unless his past contains a sizable record in practice.

Undergraduate teaching should not be considered a side line for a man whose sole interest is research. It is essentially a practical enterprise; yet with increasing enrollment and multiplication of courses, a large number of instructors must be appointed in the first place for undergraduate service. From this body are selected the professors. The requirements of a college instructor are generally neglected in looking for a man of professorial competence. The teaching ability, so important to the college instructor should not be overlooked in an atmosphere heavy with research. In some universities the success of an instructor is determined by student opinion.

Reasons generally assigned for promotions are: invitation to accept another position, increasing family and economic responsibility, outstanding work as an instructor, increased professional preparation, and general reputation in his field.

Occasionally a department head is found who reacts unfavorably to any proposed change, assigning various reasons, the real reason usually being a disinclination to change his habits. This of course handicaps an enterprising instructor.

In times of depression the instructor should not become too promotion conscious or he may later fall into disappointment and resentment with a consequent lowered enthusiasm and effectiveness.

Inferior teachers cannot be kept out of a university altogether but a wise scheme of promotion could keep them in their places rather than letting them move up to the higher places by force of

inertia or right of seniority. The latter is very discouraging to a deserving young man.

An instructor in an engineering school has very little problem with academic freedom. He should, however, conscientiously respect such limitations as are imposed by the bounds of his own competency.

Tenure is important because under good tenure conditions an instructor will render better service to an institution.

It is desirable that the load now carried by the average instructor be reduced. The general objection to a reduction is that it would not give the instructor sufficient work to do and thereby promote indolence. This would seem to be unsupported by evidence. The overwhelming benefits of leisure time to be used in self improvement would outweigh any possible disadvantage.

The Young Instructor's Future

The outlook of the young teacher is for a smaller income than if he went into practice. He generally starts at a higher salary but at the end of one year his income is approximately the same as that of his practicing fellow graduate. At the end of thirty years the medium income of the engineering teacher is about three fourths of that of the practitioner. It is difficult to expect a young man of spirit and ability to remain in teaching if he must occupy an inferior position as judged by the standards of the social and economic order in which he lives.

Desiderata

A broad philosophy of teaching that can be adjusted in detail to meet the needs of a particular course is desirable in every individual concerned with teaching. To this end some instruction in the art of teaching by means of helpful suggestions or staff conferences may be of value. The teaching load should be reduced to a point where the instructor may have time to devote to research or to study in his chosen field, for during this time scholarly habits are most easily acquired. Personal contact with superior officers and sympathetic counsel frequently lessens seemingly unsurmountable difficulties. The administration should help the young instructor to further his experience in every way possible. Aid in securing vacation employment should be given. Other desirable items include: library facilities, opportunity to visit other classes, traveling expenses to meetings of learned societies, laboratory facilities, opportunities for exchange instructorships, and a feeling of faculty coöperation. Toward the stimulation of able teaching a

number of items contribute. Among them, a well defined program of advancement which does not completely smother hope of irregular increases in salary and promotions in rank. Sabbatical absences, leaves for special investigation, separation of salary increases and promotions, provision for participation in professional organization and high maximum salaries, all do their part.

The position of the instructor should be made as attractive as possible, and the opportunities for advancement should at least be equal to those in other professions.

OUR PURPOSES AND AIMS IN THE EMPLOYMENT OF COÖPERATIVE STUDENTS *

By A. S. HOTCHKISS

Director of Training, Tennessee Coal, Iron and Railroad Co.

In reviewing "Our Purposes and Aims in the Employment of Coöperative Students" three basic factors tend to stand out: *First:* All education, including coöperative education is being reëxplored, rëvaluated and reinterpreted. *Second:* Industry has tremendous facilities as a laboratory for coöperative learning, and *Third:* Cooperation between industry and education is essential to further progress.

The coöperation, coördination and integration of the facilities and professional insight of industry and education offer the promise of building a personnel trained to meet the highly technical requirements of modern industrial practice and of life in a modern society.

It is our purpose and aim to build a coördinated training program in which theory and practice are taught concurrently in order to develop skilled employees for the current and expanding operations of our industry and to coöperate with educational forces to achieve these objectives. It is toward an interpretation of these purposes and aims that I now wish to direct your attention.

The reason for and the goals of a program of coöperative education must be considered from the coöperative viewpoint of both industry and of education. Too long have these great social forces been separated by artificial barriers. The time has come to reorient our thinking in terms of how may industry and education develop an effective training program for the youth of the on-coming civilization.

Three powerful groups of social influences have held back this development so urgently needed. Public opinion about school and college functions has been very conservative. The introduction of new ways of doing things has been difficult. Again, national experience, until recently, has been accumulating under the dominating influence of pioneer life, wherein the great open spaces absorbed the shocks of our national existence. Further, powerful prejudices, such as the exaltation of the mind and contempt for the

* Presented at the Conference on Coöperative Engineering Education, at the 46th Annual Meeting, S. P. E. E., College Station, Texas, June 27–30, 1938.

practical, have survived too long in the cultured public mind and have handicapped the development of the fullest type of coöperative training between industry and education.

To-day's world, so closely integrated, cannot longer afford the expensive luxury of these older superstitions and of new suspicions between education and industry. The times require coöperation. Said Mark M. Jones, President of the Akron Belting Company, at a recent meeting of educators and industrialists—"I believe . . . that in a rapidly advancing technological age, education seems literally the only practical force which may soberly be considered as standing between civilization and chaos itself." Here, indeed, is a challenge to both industry and education. The training program of a coöperative educational plan is in the broadest sense of the word truly educational—a leading forth, thus developing, cultivating, expanding, strengthening, disciplining and preparing the individual for life by systematic instruction.

We feel that the function of coöperative education is to provide creative experience in real life situations through which the individual coöperative student learns to think, act, and feel effectively on matters that are important and significant in the practical life of the occupation, the home, and the community.

It is a coöperative venture, concerned with the student's gradual adjustment to industrial and college life and with his whole future as an individual and as a citizen. It offers a plan leading to a normal development of future youth, wherein the work experience stimulates his interest and helps to facilitate the coöperative student's social adjustment. The employer is a co-partner with the educational institution stressing realism in education, willing to share responsibility and cost in order to build a solid foundation for continuous growth and improvement of its personnel, which in turn will be reflected in better workers, better work and better men. Looked at in this way the coöperative educational plan becomes a working part of a real enterprise to improve the entire life of the individual and the community. It is hardly necessary for me to justify to this audience the great need for coöperative effort on the part of all social forces and institutions, including industry and education, to share in the development of this opportunity to assist in solving the problems that confront the American educational system.

Educational changes are being made and are manifested by the recent development on a large scale in the junior high school, in the technical high school, in junior colleges, and in a great variety of liberal arts, technical and professional courses in secondary schools, colleges and universities in various parts of this country and the world. Early American educational institutions had a

concept of universal vocational and cultural training, which was still further developed by the land grant colleges and endowed institutions, and now there lies before us the opportunity and the responsibility to develop to its largest possibilities a type of educational guidance and vocational training that will make outstanding contributions in solving some of the pressing problems of our day. Do you not think that we should see our opportunity for educational service and grasp it? The moment we see and grasp our opportunity there develops, in full light, the basic purposes or reasons for believing that coöperative education has value from the viewpoint of industry.

Readily we understand that the greatest learning comes when theory and practices are taught concurrently. When the practice is taught without the theory industry suffers; so does the learner. When the theory is taught without the practice, the college has an almost insurmountable difficulty to overcome—in fact has not been able to properly meet the situation. The sensible answer is—cooperative education.

In industry, the coöperative student supplements his college studies with other kinds of educational experience based on situations in real life. In the practical operations and in the noise of the great shop, the student is exposed to opportunities to develop real responsibility—real things are taking place—men are depending upon him—here indeed is reality far beyond the capacity of the college to provide. Initiative growes through having to initiate —to start. Something happens—what shall he do? Some theory, some experience, some self-reliance, some common sense—the answer comes. Perhaps he makes mistakes for a while, which is a part of the learning process. Gradually he acquires skill and knowledge. He goes back to school—the theory takes on a new emphasis. So we see that a major purpose is to enable the student to take part in real life situations and to offer him the opportunity to acquire such traits as responsibility, initiative, self-reliance and the use of common sense based on his available experience.

Our coöperative education programs give the students the chance to do the work themselves under the close range observation of practical men—many of them deeply interested in the progress of the student and only wishing that they themselves had had the same opportunity. These men are a fine influence to implement the purpose of the coöperative education program. Their teaching knowledge would largely go to waste without these students. Do you not think it wise to make use of this great locked-up skill? Such is our purpose.

It is our experience that accomplishment is largely and rightfully dependent upon the man himself. Formal college qualifica-

tions—passing the regent examinations—these things have great difficulty in evaluating for industry such traits as character and native ability. How many Lindberghs have been wasted because too much emphasis was placed upon grades? Out in the shop, irregular work habits emerge through the jostlings of the commonplace. Absences, lack of mental and physical alertness, carelessness of all kinds, abuse of equipment, rate of learning ability, energy, application to the job, ability to make practical suggestions and the worker's general attitude toward life and his fellow men come to the surface where all may see and evaluate. Our coöperative training courses give us the chance to see the student in action under fire—then we know more about his mettle, more than his sheepskin can tell us. It is our purpose in building a better personnel to evaluate these things.

One of the outstanding needs of our times is rational personalities who are sane in their outlook on life, and who are able to interest and influence people in a constructive manner. In the not so distant past, personality was regarded as an indefinable something —you had it or you did not have it. Now we know that personality can be trained and developed just as other desirable qualities can be developed. This ability to influence other people is made up of habits and skills which can be acquired by practice. Personality does not grow on bushes, to be plucked; nor may it be absorbed from the printed page. Personality is expressed in everyday actions, and physical effort is one of the greatest developers of personality. Active participation in affairs, with many contacts, meeting and introducing people, making friends with both sexes, refraining from so-called frank criticism, acquiring a sense of poise and economic independence and a disciplined mind and body, constitute a wide range of skills and abilities which are underlying factors that develop personalities. Real life situations, off the campus, offer the coöperative students a vast new world to develop personality. Practical work in industry widens the field for the accelerated development of these personality traits in college students. Practical work in industry gives us at least a partial solution to the paradox which so many of us have seen of the college man whose mind constantly improves and whose personality constantly shrinks.

Everywhere in life, including industry, there are qualities of personality that lead on to progress. In actual life situations of the work-a-day world the coöperative student sees, evaluates and understands better those things that cause separation between men —suspicion, hatred, unfairness, lack of sensitivity to the other fellow's problems, stupidity, and other bad qualities make for separateness that leads to living fossilization or extinction, while their reverse makes for unity, for teamwork, for coöoperativeness,

for abiding loyalty and progress. We should be on the lookout for men with these qualities of personality that unify—they are potential leadership material. It is our purpose and aim to aid in the promotion of the development of personality, and the laboratory of industry offers this added opportunity to the program of the college campus.

The observations of regular college students, industrial operating heads and the coöperative students themselves leave the impression that the college has not made it possible for the coöperative student to improve his personality through college contacts as much as do the regular students. Lack of funds, long and continuous study hours, and the student's overstimulation of the quest for text, lecture and laboratory knowledge may be the cause of this deficiency for the coöperative student. Spinning his propeller too fast may create such a vacuum that he fails to make the desired progress in personality development through extra-curricular activities available in college. Here is an opportunity for the college to give personal aid and guidance so that the proper balance of work, study and recreation that contributes to personality may be realized.

Our purpose in coöperative education would fall short of its possibilities if we did not constantly avail ourselves of the opportunity to aid each student to achieve the highest individual development of which he is capable. It is our business to explore, in coöperation with the student, his undeveloped potentialities, and to guide and direct him as well as our experience and intelligence will permit. We know as an historical fact that apprenticeships are worthwhile in direct proportion to the amount of personal contact and interest of those in charge of the program. Educators are coming to agree that progressive education must be characterized by a personal guidance, and industry offers an extremely practical form of this type of guidance.

The coöperative student does not need to wait, in fact, should not be allowed to wait, until graduation to find his opening niche in the world's work. Over the period of five or more years of his coöperative course, he has faced many different types of industrial experience. He has been under the observation of capable men, many of whom are personally interested in his success. By means of a sympathetic understanding of the student's personal reactions in school and on the job, an improved type of guidance becomes possible. Further, when industrial operating men and educators sit down to work out related subject content, coöperative guidance will take on new meanings and a vastly improved effectiveness. We feel it is our business to do our utmost in this developing field of coöperative guidance.

It has been our experience, as well as that of many other indus-

trial concerns, that the best way to start building a strong personnel is through careful selection by the employment department at the very start. Intelligence, preparation, temperament, ability and potential leadership are assemblages of traits which are important in building a successful career. To rely upon kinship where reason may be thinner than blood; to appoint, because no one else will take the job; to allow such ancient and outmoded superstitions as shape of head, curl of mustache, religion, or whether the applicant looks you "straight in the eye," to rule in the selection of personnel is not only unscientific, unsatisfactory, and expensive, but it is most unfair to both applicant and company alike. We are far more interested in ascertaining whether the applicant has indications of the things that we all think of as a genuine sense of integrity, as good judgment, as a well balanced sense of his own worth, and as adaptability to different situations. We look for his coöperativeness, his learning ability, his courtesy and consideration of the personalities of others; his personal health and appearance, his home life, his adjustment to the opposite sex and his ability to get things done. The best of the present available tests, plus the best type of diversified personal interview, still leaves a wide gap between what you think is fact and reality itself. In this field of selection, much remains to be done. It is a prerequisite to real guidance.

In view of this condition, all we can do is to avoid negative superstitions, use such tests and interviews as show high validity and put the selected applicant to work on the job. Thereafter we have the real test in life situations. With alternate periods of school and shop over a period of five years, we can give much more reliable answers than if we considered just school work by itself or just shop work by itself. Here is a place for real coöperation between school, student and shop. Here is the preliminary laboratory of testing. If honestly evaluated, there is none better. It is real life. It is our earnest belief that coöperative education offers this unique opportunity for the selection of permanent personnel. It is because of this belief that industry has a real testing laboratory for personnel that we feel educational institutions should coöperate to the fullest extent with industry in the selection of cooperative students.

It is a common sense arrangement that allows a foreman or supervisor to make the final selection of the men who are going to work with and for him. Likewise, it is good common sense to have industry sit in with the educational institution in the selection of the coöperative students which these two educational forces are planning to train coöperatively. There appears to be a very excellent opportunity to improve the selection of coöperative stu-

dents through coöperative selection. Each year there are admitted into industrial organizations graduates of engineering schools who have excellent records of achievement insofar as scholastic studies are concerned. Perhaps, in the past, we have relied too strongly upon scholastic grades for selections. Do you not think we are in need of improved methods for making coöperative selections and for follow-up guidance?

We are in need of operating and maintenance engineers who are cost conscious and cost consciousness is seemingly something that must develop under the rush and sweat of actual work. A most thorough grasp of statistical information, including its interpretation, is essential to the embryonic engineer, but statistics are valueless unless integrated with everyday practice. The coöperative student, after following through an installation, a repair or new construction on the actual job, sees the intimate details of the need for extreme attention to costs. He sees new ideas coupled with new equipment actually tried out. He becomes intensely interested, if he is the right type, in the workability of the scheme. He couples his data knowledge with actual job knowledge. We believe the coöperative student is in an extremely favorable position to add to his college technical training through practical and applied training in costs, which is so essential to modern engineering practice.

The actual or potential industrial leader now, as well as in the future, must have a working knowledge of how to manage his own department or departments just as though his own business might be at stake—in fact his job (which in reality is his business) is at stake. Modern business regards cost and budgetary control as essential tools with which to measure accomplishments. When the young engineer acually sees and takes part in demonstration after demonstration of operations and of maintenance carried on within budgetary allowances, he has taken a long step toward eventual success. He becomes cost conscious in a natural manner. We believe the coöperative student has this superior advantage over the non-coöperative student engineer in a practical knowledge of what makes costs.

Those of us connected with industry keenly realize the need for safe industrial practice and we are alert to use every means at our disposal to develop a personal attitude of habitual safe operating practices for every job. We think that safety must be made an integral part of the esprit de corps of every operation. The cooperative student engineer comes in constant contact with the urge to keep the shop clean, to guard dangerous machines properly, and to form habits that will aid him in protecting himself and others against man-failure. Human life is conserved and costs

are improved. The coöperative student engineer grows naturally into the prevailing custom of safe practice or eliminates himself from any further usefulness to his employer by his carelessness. If he cannot be developed into a safe workman, it is dangerous to have him around and he is not potential leadership material. His work gives us the opportunity to evaluate his safety mindedness over a period of time and this aids us in building a better type of personnel.

The coöperative education plan provides industry with an effective method of employee training through which high type employees may be located, trained and matured on the job without the necessity of conducting an unduly expensive plan of finding, selecting and training employees. Vocational adjustment takes place throughout the course and thereby lessens "turnover" of employees and consequently saves money for industry.

When the coöperative student is graduated, he has been able to earn a large part of his educational expenses without sacrificing the continuity of his educational or related practical work, and he steps out into the world of real affairs, prepared to do his part as a stable, well trained and adaptable citizen. These interpretations of our purposes and aims in the employment of coöperative students are suggestive of why industry sees value in the plan of cooperative education.

II

Since July 1, 1924, coöperative education has been in effect between the Tennessee Coal, Iron and Railroad Company and the Georgia School of Technology whereby students are paired, alternating periods of work in various operations with three months of work with college studies of a like period for five years. Beginning in December, 1937, a similar arrangement was completed with the University of Tennessee and at the start of the regular college year last fall, a coöperative plan went into effect on the semester basis with Alabama Polytecnic Institute. It is the policy of the Tennessee Company to consider the coöperative student as a regular employee, filling a necessary and worthwhile place in the organization, accepting the same general responsibilities and rules as other employees. The coöperative students receive a scheduled rate of pay which increases from year to year until the course is terminated. These job earnings are based upon the type of work which the coöperative students perform. At this time these earnings amount to approximately $85.00 per month for the first year, with regular annual increases to approximately $125.00 per month for the fourth year. Altogether at these three educational institutions there are forty students who are employed and alternate on

twenty jobs on the coöperative plan. Eight of these are in the industrial engineering department where they are assigned to the works industrial engineers at the various operations. The first few weeks they are in our employ they familiarize themselves with the work of the various departments of the plant through observation and instruction. Later they are trained in time and motion study and they are also used for gathering data in connection with methods, standards and other phases of industrial engineering.

It is our experience that the coöperative students in industrial engineering profit more by experiences in the operating and maintenance departments, than when connected with staff departments. In the operating department they have the opportunity of learning how to work the equipment and something about its proper care and maintenance. They learn how to adjust themselves to their own work and the work of others and they have a personal contact with the supervisory set-up, all of which is not available in the staff departments. Further, to achieve constructive results in the industrial engineering department, it is essential that the correct impression be made upon the operating forces, and familiarity with operating mind-set and problems is invaluable experience which can be gained only through contact with operating and maintenance forces. Coöperative students placed in staff departments have little opportunity for accepting creative responsibility and their duties tend to gravitate toward routine and clerical activities.

The selection of Industrial Engineering coöperative students is very difficult because of the limited understanding and interest which the regular high school graduate has of the fundamental principles and practices of industrial engineering. He needs further seasoning to help determine his qualifications for industrial engineering work. This would seem to indicate that the best procedure to be followed in selecting coöperative students for industrial engineering would be to make a survey of the coöperative students already employed in the operating departments and from these select the ones showing desirable qualities for future industrial engineers. These observations are the result of several years of experience and we believe that the suggested procedure would be an improvement over present practice.

Eighteen coöperative students have been placed in the electrical and mechanical departments of the various operations where they have been assigned to motor and control repair work, general practice covering maintenance, or as switchboard operators, armature winders, and at times as assistants in related clerical work. Four men have been assigned to the metallurgical laboratory at the new Tin Mill where they are doing routine analytical work. Our chemical laboratories have four coöperative students who do analytical

work on materials and products, assist, in an emergency, the regular full time employees and handle a small amount of office work. In the steam engineering department two coöperative students assist in general tests and compile data of the plant for the office. The rail transportation department has two coöperative students who are engaged in general machine shop practice, and the water transportation has two men who are assigned to general marine repair work in the mechanical division.

It is readily apparent from the foregoing statement that the paired forty young men, engaged in practical work on twenty jobs in the industrial engineering, electrical, mechanical, metallurgical, chemical and steam engineering, and the rail and water transportation departments, are having actual job experiences in real life situations that are a very valuable part of their education as engineers.

III

There is an oriental tradition that nothing can be a real artistic creation unless it appeals to the eye, the mind and the spirit. A Chinese poet, Pai-Tai-Shun, says in:

An Artist's Precept

"I would not paint a face
  Or rocks or streams or trees—
Mere semblances of things—
  But something more than these.

"I would not play a tune
  Upon the sheng or lute,
Which did not also sing
  Meanings that else were mute.

"That art is best which gives
  To the soul's range no bound;
Something beside the form,
  Something beyond the sound."

The Oriental sees on past the beautiful or the pretty, whether in word or form, into the reality that comes out of one's head and heart and makes sense. The Far East has the tradition that nothing should be started piecemeal, on paper, or cloth, or ivory or wood or jade, until the entire design is understood and felt with completeness in the mind. A painted dragon, a poem, a piece of embroidery, a teakwood chest is something that must be thought about, meditated upon for hours, days, weeks, even months or years if necessary, until the workable design is so complete that when the eyes are closed the finished pattern stands out so vividly

that the whole can be made real from memory. And whatever the artist creates he must—to give it sense—think life into it so constantly that it becomes a living piece of work. Then—only—when the work is done and the thing lies before him—he must add to it a drop from his heart by pricking a finger and letting the blood touch it. Thus does it become alive in the life of men.

Inadequate as we know our artistry to be to paint the entire picture with all its meanings, we do recognize the fine opportunity and the great responsibility which this society has for the further development of coöperative education—to make real "those meanings that else were mute." Coöperative education is in need of integration—getting parts together—thereby giving it coherence, centrality and unity to make real a greater service.

May I paint a picture of a continuous research committee of your society coöperating with industry in formulating an advanced type of coöperative education—a thing of the mind become real through thought and practical application? And first of all this research should be sure to have the right attitude. It dare not be just another appointed committee—it must be a thing of life, serving adequately here and now. To have value it must permeate to the actual student on the firing line. He is in need of your trained and practical intelligence. Do you not feel the thrill of the artist who sees a problem, knows he does not have the answer, believes he has the ability to recognize truth, is earnest in his search for more satisfactory answers? Have we the courage to search out areas of inadequacy, seek answers, fix procedures for further testing in actual life situations? Do you not care to initiate the research of some specialist group whose objective would be to make a systematic attempt to solve the problems of coöperative engineering education—a continuously progressive business? Do you not think it worthwhile to organize further for a frank sharing of experience, to develop pertinent findings to be translated into immediate practical services to coöperative education?

Coöperative education has a glorious achievement to its record —it does not need further selling—it now needs coöperative development and coördinated effort to meet the needs of our modern civilization. In order to be of service, information of a factual type must be gathered and translated into current needs and possibilities. We must be keenly aware of our common problems and stir our groups to see these problems and their possible solutions. We must be moderately sure that we are starting from a premise that is true and not one based on numbers and voice. In keeping with true artistry such research will work on the basis that the answer presented is the best answer until a better one is found. Such research may well be problem finding and then problem solu-

tion to the best of our ability. Validity will be needed from several angles and a coöperative, critical attitude of constantly seeking a better answer is essential. This is a challenge to our thinking.

Summary

If I were to attempt to sum up the newer outlook toward cooperative education as it has impressed me as an observer and as a worker in the field, I should mention these specific things as important:

First.—Coöperative education is being reëxplored and reinterpreted. The impetus is now coming from both industry and educational institutions. We are beginning to see that we need each other. We see that each has a place in the training program for youth and adults. For the nation as a whole this is a moment of infinite promise. Here is our opportunity.

Second.—Industry has tremendous facilities as a laboratory for coöperative learning scarcely touched, as yet, by educational institutions.

Third.—Coöperation between industry and education should be blended in right proportions, with increased effectiveness for both.

"That art is best which gives
. . . .

IS THERMODYNAMICS MECHANICS?*

By ARTHUR S. ADAMS

Assistant to the President, Colorado School of Mines

The subject of this discussion is no cross-examiner's question to be answered with an arbitrary "yes" or "no." Too often in the past courses have been assigned to departments or reassigned from one department to another because a similar question has been answered too superficially and arbitrarily. I am sure we are all agreed that education has suffered greatly from the practice of dealing out courses like the hands in a card game. We do not want a deal—either an old or a new one—which will place Thermodynamics in the Mechanics Department simply because it will enhance departmental prestige or because it is expedient or convenient to do so. I believe that what we do want is a careful examination of the evidence concerning the relationship between the two subjects. If it turns out that the relationship is both real and significant, the further question remains, "What is to be done about it?" The discussion of this, however, may profitably wait until we have come to some conclusion with respect to the original question.

The evidence pertinent to the nature of thermodynamics and mechanics falls into three convenient classifications. The first includes that which may be learned from the historical development of the two subjects; the second is made up of data relating to their present content; and the third comprises those evidences of kinship, not now explicit, which could be made clearer with both ease and profit.

I believe the best way to see what relevant evidence history can supply will be to summarize briefly the development of the two subjects. From the historical point of view, anthropologists agree that the two events which have affected the development of civilization most profoundly were, first, the invention of tools and implements and, second, the discovery that heat could be used as a source of mechanical work. The sciences stemming from these two discoveries are clearly mechanics and thermodynamics. The date of the invention of implements like bows, levers, and especially the wheel is lost in antiquity. Not much real progress in developing knowl-

* Presented at the Conference on Mechanics, at the 46th Annual Meeting, S. P. E. E., College Station, Texas, June 27–30, 1938.

edge of mechanical devices was made until the time when Greek civilization was at its height, approximately 700 B.C. to 200 B.C. Although the Greeks did much to correlate knowledge of mechanics existent at that time—knowledge which the Romans put to good engineering use—they failed, for many reasons, to discover the fundamental principles of the science. During the period when Rome was the world and for a thousand years thereafter no further advance was made. Then Galileo initiated the study of nature by controlled quantitative experiments. From then until the time of Newton the organization of knowledge concerning the action of forces on matter proceeded apace. With the enunciation of Newton's three laws of motion the real foundation for the science of mechanics was laid. All that man has been able to do since then has been to extend the applications of those principles.

Just as the discovery that forces could be utilized to control nature affected civilization, so did the discovery that heat could be used to do mechanical work. From the time when man learned to make a fire until Watt's practical development of the steam engine, scientifically minded individuals had wondered about heat phenomena. Their curiosity lead them to make many experiments. As early as the second century B.C., Heron of Alexander constructed an ingenious altar so arranged that when a fire was built upon it, the heated gases of combustion caused the opening of doors to a shrine. Such inventions and developments, however, had very little meaning until the same method of investigation that had been applied so profitably in the field of mechanics was applied to the study of heat phenomena. In this application Galileo was again the first. His invention of the thermoscope removed the subjective estimate of temperature prevalent until his time. But heat was still an unknown subject until Black made his investigations on the nature of heat quantity. Even he believed it necessary to invent a mysterious fluid to account for the passage of heat from one body to another. Nevertheless, his measurements made by the method of controlled quantitative experimentation were exceedingly valuable in putting the science on a factual basis.

Finally, in 1798, Rumford, a man well trained in mechanics, brought forth the first evidence that heat was not a mysterious fluid but was no more than a form of energy. I believe that we may take the date of Rumford's discovery, nearly one hundred fifty years after Newton's time, as the real beginning of the science of thermodynamics. This despite the fact that Savarin (1698), Newcomen (1705) and especially Watt (1765) had developed the steam engine to practical usefulness years before. Perhaps it was because of this usefulness that thermodynamics, from the start, had a distinctly engineering flavor. What was more natural than the

thought that thermodynamics was the science brought into being to explain the action of the steam engine. It was the engine, not the science, that affected men's lives. Indeed, it was the development of the steam engine, together with an understanding of the mechanics of machinery, which brought about the second great change in the character of civilization mentioned above by causing the so-called "Industrial Revolution," the effects of which are of so much concern to us to-day. When any discovery has such a far-reaching effect as did this one, the human mind always becomes concerned with the way it works rather than with the principles that cause it to work. So it is with thermodynamics. Because of the enormous practical significance of the steam engine it was natural that attention should be given to the details of its operation rather than to the more fundamental fact that here at last was a way by which man could harness heat energy to provide for his added comfort and convenience. With this thought in mind, it becomes clear at once that engineering thermodynamics was bound to develop as a study of engines rather than a study of *energy*. This explains why we find engineering thermodynamics usually taught to-day in the mechanical engineering department.

The development of engineering thermodynamics, however, is only a part of the history of thermodynamics as a whole. Two other important scientific fields have been and still are vitally concerned with the science. The first is physics. It is worth noting that although Carnot, an engineer interested in improving engine efficiency, laid the basis for the second great principle of thermodynamics, his work was not of fundamental value until the physicists Clausius and Kelvin extended it and formulated it into the Second Law.

So great was the impetus given to thermodynamics by the formulation of this principle that for a while scientists sought to explain all physical phenomena on thermodynamical bases. They argued that it was a gratuitous assumption to speculate about the behavior of hypothetical atoms and molecules in the face of the fact that such atoms and molecules had never been observed. They thought this especially true because one could in general calculate the behavior of most physical phenomena on the basis of thermodynamical reasoning. Hence they chose to ignore the detailed study of the mechanisms of the phenomena. Their neglect of this study was a fatal weakness to their argument. This was soon shown by analyses based on the kinetic theory of gases in which the distribution and behavior of particular molecules is of first importance. Physicists, therefore, for a time took the diametrically opposite road to that followed by the engineers. They depended entirely on thermodynamical principles and excluded consideration of mecha-

nisms. The engineers gave and give their first attention to mechanisms and use only so much of the general principles as is of immediate value.

Overemphasis of the thermodynamical method in physics led to its falling somewhat into disrepute at about the turn of the century. To-day, however, modern physicists use thermodynamics extensively but understand its limitations. Conversely many branches of modern physics have made significant contributions to thermodynamics, as is evidenced by the determination of specific heat equations by spectroscopic methods.

Chemistry, likewise, is a science which has had much to do with the development of thermodynamics. Helmholtz and Gibbs made outstanding thermodynamic contributions to chemistry during the last century which led to building up a body of knowledge concerning the relationship between heat energy, mechanical energy, and chemical energy. In physical chemistry textbooks to-day we find many pages devoted to the exposition of thermodynamical principles. Unfortunately, this material, although the same substance as engineering thermodynamics, is seldom recognized as such by the student because of the differences in nomenclature.

In many specialized schools and colleges to-day we note that courses in chemical thermodynamics, physical thermodynamics and engineering thermodynamics simultaneously exist. It must be evident that thermodynamics is a vital and fundamental subject if it is worth while to offer three different courses dealing with its applications in three other sciences. When dealing with every other fundamental science we have found that our best approach is to teach the fundamentals first and follow with courses in specialized applications. An opposite course has been pursued with respect to thermodynamics with results which in my opinion leave much to be desired. If all of the approaches to thermodynamics could be combined into one fundamental study, I am confident that students generally would profit much from their work in such a course. When one is introducing principles of such far reaching importance as those embraced in the first and second laws of thermodynamics it does not seem wise to qualify the introduction by restricting it to the applications in a single field.

The second source of evidence which yields information about the relationship of thermodynamics and mechanics is the present content of the two subjects. An outstanding principle in mechanics which has equal importance in thermodynamics is that of the conservation of energy. True, the mechanics student usually deals only with mechanical energy. He thus learns that in a mechanical system all of the mechanical energy may be accounted for. However, the great advance in scientific knowledge made by the enuncia-

tion of the conservation principle resulted from the fact that heat was identified as a form of energy. Even though the student becomes aware of this in his preparatory physics courses, I believe it is an idea of such fundamental importance that it should be constantly stressed. Most authors of mechanics text books use a scheme similar to that used by Professor Poorman for the presentation of the work energy principle. This presentation comes down to the statement that initial kinetic energy plus moving work equals resisting work plus final kinetic energy. Of course, the real basis for this statement is found in the laws of motion. To my mind, however, it gives the student the notion that the conservation principle applies only to mechanical energy, even when the work energy equation is extended to the statement of Bernoulli's theorem in hydraulics. Here, still, the energy quantities involved are exclusively mechanical. The question is often raised in hydraulics, what kind of energy is represented by the term "lost head"? Of course it is head lost to the system because it is energy no longer in the mechanical form. A distinct advance can be made if attention is directed to the fact that "lost head" represents energy transformed into heat. As soon as such identification is made we are at once in the field of thermodynamics. Professors Seely and Ensign in their excellent text book recognize this in their chapter on work and energy. After a discussion of the forms of non-mechanical energy they say, "The outstanding feature concerning energy is that certain principles of energy, such as the conservation of energy and of degradation of energy, etc., are the basis upon which our knowledge of the behavior of non-rigid bodies, in general, is built and thus they furnish a method of approach to problems for which the principles of force, mass and acceleration are inadequate. They are of special importance, therefore, in the study of hydraulics. thermodynamics, electrodynamics, physical chemistry, etc."

Although the conservation of energy principle is evidence of the broad relationship between mechanics and thermodynamics, there are many other specific evidences of more limited significance. For example, teachers of mechanics will agree, I am sure, with Professor Osgood in his statement that the man who first uttered the words "Isolate the System" deserves a "monumentum aere." Other authors give equal stress to the idea by exposition of the free body concept. Regardless of the name given it, the idea is the same in each case. Moreover, the concept of an isolated system is of equal application and importance in both mechanics and thermodynamics.

Another item of evidence is the identical mathematical treatment for the determination of centroids in mechanics and that of average gas constants and average specific heats of mixtures in thermodynamics. Likewise, the mathematics for the treatment of

conservative and non-conservative force systems in mechanics is identical with that used for the evaluation of thermodynamics for point functions and for what, for lack of a better name, might be called path functions in thermodynamics. Many illustrious scientists, of whom Massieu was the first, have gone on from this and used the ideas of potential from mechanics in their work on the invented point functions of thermodynamics.

The problems dealt with in any science are an indication of the scope of that science. Inspection of widely used and well thought of mechanics texts reveals that practically all of the authors of these texts have seen fit to include in their books problems involving the thermodynamic problem of determining the work of an expanding gas. This practice is one with which I whole heartedly agree. Most practical problems have to do with the action of a variable force rather than with a constant one. When a student has been introduced to the notion of mechanical work he nearly always reaches a stage in his understanding in which he thinks that work is simply force times distance without realizing that the force might be a variable one. The thermodynamic problem of an expanding gas, dealing as it does with a variable force, broadens his concept of work at once and shows him the relationship between mechanics and thermodynamics.

And now we are ready for the third source of evidence concerning the relationship of the subjects, i.e., evidence of kinship which could be made clearer. Reduced to the last analysis, I think we can agree that mechanics is the study of the action of forces on matter. Students of hydraulics have come to appreciate this fact in recent years and have renamed their study "Fluid Mechanics." By so doing and by emphasizing fundamentals of mechanics throughout their work they have found it possible to go much further than they could with the former empirical hydraulics. At the same time, they have come surprisingly close to the principles of flow processes used in engineering thermodynamics.

Professors Dodge and Thompson in their recent book on Fluid Mechanics demonstrate this in that they devote chapters I, XIII and XIV to material that they clearly identify as thermodynamics. In Chapter XIV especially they give considerable space to showing that thermodynamic analysis and Bernoulli theorem analysis lead to the same result. As they put it, "This (result) might have been anticipated since the equations obtained in each case are simply statements of the principle of conservation of energy."

Fluid mechanics itself received the impetus for its development from the fact that it was recognized as mechanics. Yet it deals vitally with compressible media and so includes parts of thermodynamics. To my mind it follows that thermodynamics likewise is

mechanics. Scientists in the field of fluid mechanics have recognized that hydraulics and thermodynamics respectively constitute the mechanics of liquids and gases. Analytic mechanics, of course, deals with the mechanics of solids. It seems to me that even the brief discussion of the evidence I have been able to give shows that mechanics, hydraulics and thermodynamics are really the mechanics of solids, liquids and gases. Consequently, my answer to the question initially propounded is "Yes, Thermodynamics *is* Mechanics."

CIVIL ENGINEERING PAGE

Notes of interest for members of the Civil Engineering Division.—Editor, M. W. FURR, *Kansas State, Manhattan*

F. T. MAVIS, *Chairman*
H. C. BIRD, *Past Chairman*
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M. W. FURR, *Editor*
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TRAINING ENGINEERING STUDENTS FOR THE CONSTRUCTION INDUSTRY *

One of the principal branches of the civil engineering profession is the construction industry. Hence, during the past year the Committee on Construction Education of the Civil Engineering Division, serving under the supervision of Professor F. W. Stubbs, Jr., set forth to further the purposes of the studies being made to determine the *phases of training* for the prosecution of construction enterprises that can most advantageously be taught in the engineering college. A conference was conducted by the Committee at the Annual meeting of the Society held at the A. & M. College of Texas. Briefly, some aspects of the program were as follows:

Professor F. C. Snow, Staff of Civil Engineers, Georgia School of Technology, presented a discussion on "A Coöperative Plan in the Construction Engineering Field." Professor Snow illustrated the work of the coöperative student and the advantages of the plan by referring to practices and opportunities for training in highway construction in the State of Georgia. The point was made that the various phases of the training sought in construction engineering were acquired by the coöperative student on the job in highway project work; the topographical, climatological, and geological conditions of the State being most favorable as a laboratory for a multiplicity of exercises of a scope that were not possible on a campus or in summer camps.

Coöperative work is made available to all classes from freshmen to seniors under the "Georgia Tech" plan. In due time the underclassmen become adept in the various technical phases of the work and are given promotions to take part in the more intricate engineering problems. The civil engineering field is broad, and the students are placed in all branches of the profession including the construction of private and industrial buildings, foundation work, piers, walls, columns, steel structural projects, sewerage, water supply engineering, etc. Also, many of the students are assigned to offices and drafting rooms to undertake such problems as arise in connection with designing and estimating.

Following through a program of the nature and magnitude outlined, spanning from the elementary to the semi-professional and managerial positions, Professor Snow believes that the plan doubtless gives the student

* Review of papers presented at the Annual meeting of the Society, A. and M. College of Texas, June 27–30, 1938. Professor Snow's paper was read by Professor L. E. Conrad of Kansas State College.

engineer a very complete picture of the work, knowledge, and technique indispensable to the civil engineer, and that it results in good success when the course of study, training, and experience is completed.

Mr. C. D. Wells, Construction Engineer, of the Texas Highway Department, continued the discussion by a paper entitled, "The Engineering Graduate From the Viewpoint of the Construction Industry." Mr. Wells emphasized that the function of the college or university was to give a rigorous and intensive training in the fundamentals of civil engineering to all undergraduate students. Students who have incentives to enter the construction industry or prosecute the work of design or what-not should receive the same training, because the successful designer, for instance, must have knowledge and experience of construction and vice versa. Admittedly, some students will become better construction experts than others, whereas, there are still others that will develop and go to the top in the field of design. This is a reason, and a very good one, for giving undergraduates uniform training and education rather than to permit specialization to satisfy the ostensive desires of some students to attempt to do so. Specialization, however, is probably the exception rather than the rule for the engineering schools operating on a four-year curriculum basis, and it is not always a problem of complexity.

Another point made by Mr. Wells was that the schools were not giving sufficient training to students to enable them to make contacts and maintain the good will of employers or contractors. It was suggested that this need could be met to some extent, at least, by giving instruction in courses in psychology, English and English composition, accounting, and the precision of measurements. Such preparation was believed to be indispensable to future accomplishment. In general, the engineering student must also have thorough training in the solution of technical problems, such as will be encountered in the practice of his profession. This will develop and encourage individuality and resourcefulness.

It is important to have the engineering student understand the value of a wide knowledge of technical reference books and current literature on engineering subjects. General reading outside the text and of library references is quite necessary. Finally, Mr. Wells believes that the plan of cooperative training is effective, although, not always practicable. In its absence is the plan of summer employment for the student-engineer, a plan also valuable and commendable.

Another school of thought is to have education and training come first and then depend upon experience, with continued study, to culminate with professional practice.—M. W. F.

ENGINEERING ECONOMY PAGE

Engineering Economy is that phase of engineering work in which technical plans and operations meet the critical and constructive tests of applied economics.

EDMUND D. AYRES, University of Wisconsin, *Editor*

WHAT'S IN A MASTHEAD?

Last year the appeal went out from this page for suggestions for an appropriate masthead to be carried in italics at the top of every Engineering Economy Page from month to month. Six different mastheads have been received from six different authors and each of these has been used at least for one printing. A poll of last year's Committee on Engineering Economy resulted in a tie between the masthead used above and the following:

> Engineering economy specifically relates to the cost aspects of engineering in all phases of the practice of the profession: planning construction, production, distribution and utilization. Engineering economy in education relates to all the cost aspects of engineering in practice and in addition serves as a threshold through which the engineering student may be directed to an interest in and future participation in the administration and management of industry and civic affairs.

Chairman Grant is much interested in this matter of masthead selection and promises to bring it to the attention of this year's committee for further consideration.

Your editor feels that the policy of this page should be bounded by the expression of scope delineated by the masthead finally adopted. An examination of the two mastheads given above reveals a wide difference in the fields circumscribed. In a partisan sense they represent a distinct liberal versus conservative construction of policy. A choice between them will operate to expand or restrict to a considerable measure the subjects acceptable for treatment in this page. As a reader what sort of masthead do you consider most suitable?

"Sunk Cost Gospel"—Confusion of Economic and Financial Problems

This is my comment upon the replacement problem controversy between Will B. Practical and Professor Dooley Clear appearing

in the October issue. I am of the opinion that we have been confusing two types of problems and two types of decisions in our teaching of engineering economy. These two types of problems are, first, economic and second, financial.

Concerning "sunk cost gospel," it is possible in the case mentioned that a certain project is feasible on "economic" grounds. It may not, however, be true that the project is financially possible. The financial solution of "the unamortized values" of this problem could be:

(1) To charge "the unamortized values left on the accountants' books" to surplus.
(2) To charge "the unamortized values left on the accountants' books" to profit and loss.
(3) To allow the unit cost of the product produced by the new project to remain unaltered until the saving in unit cost, brought about by the replacement, multiplied by the proper quantity is equal to "the unamortized values left on the accountants' books." After that quantity has been produced use the actual unit cost brought about by the new project.

C. E. BULLINGER,
The Pennsylvania State College.

ENGLISH NOTES

DEVOTED TO THE INTERESTS OF TEACHERS
OF ENGLISH IN ENGINEERING SCHOOLS

J. L. VAUGHAN, *Editor*

ENGINEERING SEMINARS FOR UNDERGRADUATES*

The use of courses, which are termed seminars, as vehicles for the dissemination of material not ordinarily found in text books is by no means new. As a matter of fact seminars are the rule rather than the exception in the graduate curriculum. However, the inclusion of such courses in the undergraduate curriculum is less frequent and often presents a problem. This may be due to several causes, of which the principle one is that the average undergraduate has not yet developed that thirst for knowledge which is often characteristic of graduate students.

It is my intention this afternoon to present a plea for these undergraduate seminars since at this institution we have such a course included in the curriculum for our Senior Chemical Engineers. We have found it to be one of our most valuable courses and our students frequently inform us to that effect. They exhibit a great deal of enthusiasm about the course and many voluntarily attend more than their own section.

A brief description of the course would not be amiss since it is my intention to use it as a basis for this discussion. It is a one semester course carrying one hour credit given during the latter half of the senior year. The classes meet one hour per week and at each meeting three members of the class present talks of fifteen minutes each with brief intervals between for discussion. Frequently the discussions become so animated and extended that it is necessary to halt them because of lack of time. Because of the fact that undergraduate classes tend to be large, it is not possible to allow more than fifteen minutes for each article.

* Presented before the English Conference of the Forty-sixth Annual Meeting of the Society for the Promotion of Engineering Education at College Station, Texas, June 27, 1938, by F. W. Jensen, Professor of Physical Chemistry, Agricultural and Mechanical College of Texas, College Station, Texas.

A seminar of this type may be made to serve a dual purpose. In the first place it can be used as a powerful tool in aiding the student in the oral presentation of technical material, and in the second place the students are benefited by the review of a large number of journal articles on subjects ignored or only partially discussed in their other courses. The second of these two purposes is too often stressed to the more or less complete exclusion of the first.

A frequent and undoubtedly justifiable criticism by the industries concerning college graduates is that they are woefully lacking in the ability to present reports in logical and concise fashion. We are inevitably forced to one of two conclusions. Either we, as teachers of engineering, are overlooking an obligation to our students in this respect, or we are blandly assuming that such training is the responsibility of an already harassed and overworked English Department. Does the training leading towards the able presentation of technical material fall within the province of this Department? That is a debatable question. It must be admitted that there is a lamentable tendency towards shifting onto the English Department the full load of the responsibility of the student's English both written and oral in all their courses. Of course, this is due to the fact that other departments are busily engaged in the administration of their own courses. It is our contention that these other departments can coöperate materially in such training of undergraduates with very little inconvenience and very little extra effort on their part. It is true that English Departments offer courses in Public Speaking. Without doubt these courses should be made a part of the Engineering curriculum. However, these courses cannot be expected to cover any training except that which is general and fundamental. Training in the presentation of specialized technical articles must be the responsibility of the departments offering various engineering courses. There is no course in which such training can be given as efficiently as in an undergraduate engineering seminar. The type of material which can be taken up in these seminars is admirably suited for such training. As a matter of fact it is partly on this basis that we "sell" this course to our Chemical Engineers. They hope and we hope that the day is not too distant when they shall have risen in their special line of endeavor to the point where it may be their good fortune to present a proposition of theirs to a board of directors of a company. We attempt to instil into their minds that their future advancement may hinge on such a presentation. Will they be able to do justice to themselves when that time comes? Therefore they stand before their instructors and the other members

of their class just as they would before a board of directors, and acting on the supposition that they are presenting their own projects, they strive to explain them and justify them to their audience. We attempt to make the student realize that it is a privilege to receive this training rather than a distasteful task which must be performed. When students acquire this frame of mind the battle is won. Incidentally this procedure also removes the humdrum atmosphere so often existing in seminar classes.

In order that they may do this creditably, the students are trained and instructed in the proper methods of presentation as well as in the organization of material. The student is taught to be so familiar with his subject and its organization that memorization of his talk is not necessary. Oratory is discouraged in favor of clear, concise exposition. It is worthy of mention that no criticisms of any kind are offered during the class period since many students are sensitive towards criticism before their classmates. All criticism is given in private conference with the instructor. Attendance at these conferences is entirely voluntary on the part of the student, but it is very unusual for any student to fail to ask for criticism. At these private conferences, faults in diction and pronuciation, defects in tone and quality of voice, errors in grammar and mistakes in organization of the talk are pointed out. It has been found that in private criticisms of this kind it is possible to promote in the student that confidence in himself which is so necessary.

During this fifteen minute talk the student is not permitted the use of any notes. Since the talks are of a technical nature, references to diagrams, charts and tables are frequently necessary. These must be placed upon the board some time prior to the time of meeting. Furthermore, all such material must be neatly reproduced and all diagrams and charts must be drawn to scale. It is not unusual for a student to use as high as two hours to place these on the board. Under no circumstances may this material constitute an outline of the talk to be used in place of notes.

As stated before the second purpose of the seminar is that of giving the students the benefit of listening to the review of a large number of journal articles. In many seminar courses this is frequently the only purpose kept in mind. In graduate seminars it is customary to assign more or less general topics with the intention that the students search the literature for their references. In our experience this type of assignment is not suitable for undergraduates. This is usually due to one or both of two reasons—either the undergraduate is not mature enough to isolate the salient points, or the material obtainable on a general topic is actually too voluminous

to be condensed into a fifteen minute presentation. Consequently a list of approximately one hundred and fifty individual articles is selected from the technical journals. This necessitates a rather diligent search of the literature since only a small proportion of the articles found in the journals can be used as the basis for a seminar talk. In order that maximum benefit may be obtained from the course, it is essential that the subject matter shall be chosen with the greatest care.

Experience has taught us many lessons in determining what types of articles constitute good topics for undergraduates. As a general rule, the more difficult and highly technical articles prove to be the better ones. Observation shows that students prefer such articles even though more preparation and study is required. The explanation lies in the fact that these more difficult articles challenge the ability of the student. He feels that in presenting such an article he is presenting an article worthy of the attention of his classmates and instructors. This brings up a point that can not be stressed too strongly. If the student is to retain confidence in himself as he speaks, he must realize the material that he is presenting is of a type that is of interest to his listeners. It is to be regretted that this point is too frequently disregarded in many public speaking courses. It requires a truly great speaker to convert a mediocre topic into an interesting talk.

Preference is given to articles which arise from principles touched upon but not completely covered in other course work. If possible, the article should be a unit in itself. A single member of a series of related articles is ordinarily not suitable unless it happens to be the final one of a reasonably short series. Such an article is valuable in that the student is forced to use the literature in tracing the references. In all cases the student is required to investigate all essential references found in his article. In this manner the student becomes familiar with the literature. Frequently undergraduates do not get the benefit of this training.

The student's grade is obtained on the basis of several considerations. His delivery, the neatness of his diagrams, evidence of preparation, and mastery of the subject matter all contribute towards his grade. In the private conference he is shown how each of these factors has affected his grade.

In summation it may be stated that the addition of engineering seminar courses to the undergraduate curriculum is to be recommended for the following sufficient reasons.

Engineering Departments are brought into closer coöperation with the English Department in a field which is of importance to both.

Valuable training is given to undergraduates in the specialized field of presentation of technical material. This is of great benefit in their future advancement.

Students become familiar with the use of scientific literature.

The review of a large number of technical articles increases the student's field of knowledge and whets his appetite for further information.

REPORT OF THE INVESTIGATION OF ENGINEERING EDUCATION

There are available a limited number of copies of the Report of the Investigation of Engineering Education issued under the direction of W. E. Wickenden, Director, and H. P. Hammond, Associate Director. This is in two volumes, the last volume being issued in 1934. These will be distributed to members upon application for the nominal fee of 50c to cover the cost of handling and postage. Requests for these will be filled in the order of their receipt until the supply is exhausted.

Orders should be sent to the secretary, F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

MATHEMATICS PAGE

The Mathematics Division of the S. P. E. E. has appointed a committee for the purpose of collecting a set of problems from the fields of science and engineering suitable for use in courses in mathematics taken by freshmen and sophomores in the College of Engineering. The committee feels that the compilation of such a set of problems is of enough importance to all departments of engineering to ask their coöperation in the work. Consequently, they are asking that persons engaged in engineering work of any sort, and who have at hand problems not found in the usual texts, send them to the chairman of the Committee: J. W. Cell, Box 5548, State College Station, Raleigh, North Carolina.

COÖPERATIVE ENGINEERING EDUCATION DIVISION

Executive Committee

Cecil A. Kapp, **Chairman**, Director of Coöperative Education, Drexel Institute of Technology.

M. E. Nichols, Superintendent of Training, American Steel and Wire Company, Cleveland, Ohio.

J. E. McDaniel, Director of Coöperative Courses, Georgia School of Technology.

George W. Burns, Assistant Dean, College of Engineering, University of Cincinnati.

C. J. Freund, Dean, University of Detroit.

F. A. Kartak, Dean, Marquette University.

E. H. Flath, Dean, School of Engineering, Southern Methodist University.

R. C. Disque, Dean, Drexel Institute of Technology.

THE T-SQUARE PAGE

DEVOTED TO THE INTERESTS OF THE
DIVISION OF ENGINEERING DRAWING

F. M. PORTER, *Editor,* University of Illinois

NATIONAL DRAWING COMPETITION

Auspices of the Division of Drawing and Descriptive Geometry Society for the Promotion of Engineering Education

Chairman, A. W. LEIGHTON, Engineering School, Tufts College, Mass.

GENERAL REGULATIONS FOR SCHOOL YEAR, 1938–1939

1. Work is limited to first year (or equivalent) drawing courses. Students in advanced courses or who have been professionally employed as draftsmen should not be entered.

2. An engineering drawing department may submit one drawing only in each of the following competition classes: AP, AI, BP, BI, CI, CS, D, E, and F.

3. Each submitted drawing must be accompanied by a statement concerning the following information:

a. The competition class in which the drawing is to be entered.
b. The name, address, and institution of the drawing teacher.
c. The number and length of lecture or class periods, the number and length of drawing room periods, and the number of "home work" periods which were available to the student prior to and including the time spent on the submitted drawing.
d. The number of units, semester hours' credit or yearly credit, of mechanical drawing earned by the student competitor before entering college.
e. The name and address of the student whose drawing is submitted.

4. The problems and special specifications supplementing these general rules will be furnished schools desiring to enter contestants. Application, accompanied by an entry fee of one dollar, should be made to the Chairman of the Competition Committee, A. W. Leighton, Engineering School, Tufts College, Mass., who will supply the necessary problem specifications and identification numbers for the contestants; also cards for listing the information included in Paragraph 3. Specifications will be furnished contesting students through their instructors. The schools' best drawing in each competition class will be entered in the National competition. An elimination contest in each school is suggested as one means of selecting the best drawing.

The Classes in General

In all cases the drawing is to be made from the problem project supplied by the Drawing Competition Committee and in accord with the specifications and regulations which apply to the particular classification.

Class AP. Required: A pencil drawing, on tracing paper, made with instruments embodying orthographic shape description. Choice and treatment of views, as well as execution, are a part of the problem.

Class AI. Same as Class AP except that an inked tracing, on cloth (accompanied by the pencil drawing, on heavy drawing paper) is required.

Class BP. Same as Class AP except, required: A pencil drawing, on tracing paper, made with instruments, including both an orthographic shape description and size specification. Choice and treatment of views, execution, dimensioning, etc., are part of the problem.

Class BI. Same as Class BP except that an inked tracing, on cloth (accompanied by the pencil drawing on heavy drawing paper) is required.

Class CI. Required: A complete working (shop) drawing submitted in the form of an inked tracing, on cloth, accompanied by the pencil drawing, on heavy drawing paper. Choice and treatment of views, dimensioning, etc., are a part of the problem.

Class CS. Same as Class CI except that the drawing is to be a freehand orthographic sketch on plain heavy drawing paper.

Class D. Required: A freehand pictorial sketch without mechanical aids of any kind. Choice of position, method of representation, execution, etc., are a part of the problem. Line drawings are desired rather than architectural or photographic effects produced by graded light and shades with shadows, etc.

Class E. Required: Lettering in pencil and lettering in ink from written copy. Arrangement, form and proportion of letters, execution, etc., are a part of the problem.

Class F. A problem which, in addition to technique, will reward a man for originality of solution and clear presentation.

Judging

First and second places will be awarded in each class, except that no awards will be made for any class in which there are not at least five entries. Third places may be awarded at the discretion of the judges.

Theory, practice, technique, and student judgment shall constitute the basis for judging all drawings.

The judges shall be three in number, selected by the Chairman of the Division of Engineering Drawing. The Chairman of the National Competition Committee shall be, ex-officio, a non-voting member of the judging committee.

Comments

The National Drawing Competition Committee for 1938–1939 is as follows:

JOHN H. BUTLER, New Mexico State College
STANLEY G. HALL, University of Illinois
J. LAWRENCE HILL, JR., University of Rochester
FRIDJOFT PAULSEN, San Mateo Junior College
CHARLES E. ROWE, University of Texas
ARTHUR W. LEIGHTON, Tufts College, Chairman

The problems for the Competition Classes A, B, C and D have been printed in black ink (by offset lithography) on 13 pound No. 5 map bond paper by the Spaulding-Moss Company of Boston, Massachusetts. Excellent prints may be made from these sheets or extra copies of these sheets may be secured from the Chairman of the Competition Committee at the nominal rate of one cent per sheet postpaid. The specifications for Classes E and F are not available for purchase in quantities since it will probably be more economical for each department to reproduce its own copies. Classes C8 and F are being introduced for the first time this year.

During 1937–1938 forty-two institutions entered the Competition and thirty of these exhibited drawings at the College Station Meeting. The Committee's goal for 1938–1939 is to have an exhibition of drawings from at least fifty institutions at the Pennsylvania State College Meeting next June.

NEW MEMBERS

ADAMS, ROBERT W., Assistant Professor of Civil Engineering, Mississippi State College, State College, Miss. D. M. McCain, J. C. Bridges.

ALBERT, CALVIN D., Professor of Machine Design, Cornell University, Ithaca, N. Y. S. F. Cleary, C. E. Townsend.

AMELOTTI, EMIL, Assistant Professor of Mathematics, Villanova College, Villanova, Pa. J. S. Morehouse, E. L. Haenisch.

ARNOLD, JAMES E., Instructor in Mechanical Engineering, Tulane University, New Orleans, La. A. M. Dunlap, J. M. Robert.

BOCK, LOUIS S., Instructor in Administrative Engineering, Cornell University, Ithaca, N. Y. S. S. Garrett, K. T. Compton.

BRIGGS, GARLAND B., Dean, International Business Machines Corp., Endicott, N. Y. Readmission.

BUDGE, WILLIAM E., Professor of Mining Engineering, University of North Dakota, University, N. Dak. Arthur Koth, L. C. Harrington.

CEJKA, JOSEPH B., Instructor in Mechanical Engineering, Tulane University, New Orleans, La. A. M. Hill, J. M. Robert.

CLAIRBORNE, LEWIS E., Instructor in Civil Engineering, Mississippi State College, State College, Miss. D. M. McCain, J. C. Bridges.

DEVOR, ELMER L., Instructor in Mechanical Engineering, Columbia University, New York City. Frank L. Eidmann, G. B. Karelitz.

DOUGHERTY, C. R. GRAFLY, Instructor in Engineering Drawing, Iowa State College, Ames, Iowa. L. O. Stewart, O. A. Olson.

DURLAND, ARTHUR C., Instructor in Engineering Drawing, Iowa State College, Ames, Iowa. L. O. Stewart, O. A. Olson.

EMMONS, GARDNER, Assistant Professor of Meteorology, New York University, New York City. S. K. Barrett, A. F. Spilhaus.

FRASH, EDWIN S., Instructor in Mechanical Engineering, University of Florida, Gainesville, Fla. A. J. Strong, N. C. Ebaugh.

GARDNER, HOWARD S., Associate Professor of Chemical Engineering, University of Rochester, Rochester, N. Y. J. L. Hill, J. W. Gavett.

GARNER, CLEMENT L., Chief, Division of Geodesy, U. S. Coast and Geodetic Survey, Washington, D. C. J. S. Dodds, L. O. Stewart.

GILBRETH, LILLIAN M., Consulting Engineer and Part-time Professor, Purdue University, 68 Eagle Rockway, Montclair, N. J. A. A. Potter, C. W. Beese.

GRADISAR, IVAN A., Instructor in Mechanical Engineering, University of Pittsburgh, Pittsburgh, Pa. J. A. Dent, H. C. Pavian, R. F. Edgar.

HADDOX, LOUIS C., Instructor in Mechanics, University of Wisconsin, Madison, Wis. J. B. Kommers, M. O. Withey.

HOWARD, FRANK C., Professor of Chemical Engineering, Worcester Polytechnic Institute, Worcester, Mass. T. H. Morgan, C. D. Knight.

HUCKERT, JESSE W., Associate Professor of Mechanical Engineering, University of Maryland, College Park, Md. F. L. Eidmann, J. E. Younger.

HUNT, MELVIN W., Instructor in Industrial Engineering, University of Alabama, University, Ala. G. J. Davis, G. H. Dunstan.

JANES, CLINTON W., Instructor in Electrical and Mechanical Engineering, University of Arkansas, Fayetteville, Ark. G. P. Stocker, A. S. Brown.

KOUWENHOVEN, WILLIAM B., Dean of the School of Engineering and Professor of Electrical Engineering, The Johns Hopkins University, Baltimore, Md. A. G. Christie, M. W. Pullen.

KUT, WALTER S., Instructor in Mechanical Engineering, Cooper Union, New York, N. Y. H. F. Roemmele, W. A. Vopat.

LARSEN, MERWIN J., Instructor in Electrical Engineering, Michigan College of M. & T., Houghton, Mich. G. W. Swenson, H. R. Reed.

LEAR, JOHN E., Professor of Electrical Engineering, University of North Carolina, Raleigh, N. C. W. Hand Browne, B. R. Van Leer.

LINDEMAN, MARVEL F., Instructor in Civil Engineering, Wayne University, Detroit, Mich. R. H. Schoonover, A. R. Carr.

LITTLETON, EARLE F., Instructor in Civil Engineering, Tufts College, Tufts College, Mass. F. N. Weaver, R. W. Lefanour, F. H. Crabtree.

MACDUFF, F. J. N., Instructor in Mechanical Engineering, New York University, New York City. S. K. Barrett, A. C. Coonradt.

MARTIN, HAROLD R., Instructor in Engineering Drawing, Iowa State College, Ames, Iowa. L. O. Stewart, O. A. Olson.

MORGAN, RALPH A., Professor of Chemical Engineering, University of Florida, Gainesville, Fla. W. H. Beisler, N. C. Ebaugh.

NEWTON, DUDLEY, Professor and Head, Dept. of Civil Engineering, Wayne University, Detroit, Mich. R. H. Schoonover, A. R. Carr.

NOWICKI, ALBERT L., Assistant Professor of Civil Engineering, Marquette University, Milwaukee, Wis. F. A. Kartah, W. J. Hebard.

PARK, H. V., Instructor in Mathematics, North Carolina State College, Raleigh, N. C. J. M. Clarkson, R. C. Bullock.

PRIDE, H. HAMMOND, Associate Professor of Mathematics, New York University, New York City. S. K. Barrett, P. C. Cromwell.

QUERY, LEO H., Instructor in Mechanical Engineering, University of Rochester, Rochester, N. Y. J. L. Hill, W. J. Conley.

REID, LINCOLN, Instructor in Civil Engineering, College of the City of New York, New York, N. Y. William Allan, S. J. Tracy.

RITTER, IRVING F., Instructor in Mathematics, College of the City of New York, New York, N. Y. S. K. Barrett, M. C. Giannini.

RITTERBUSCH, HARRY F., Instructor in Machine Design, Stevens Institute of Technology, Hoboken, N. J. F. D. Carvin, F. D. Furman.

ROSE, WILLIAM A., Assistant Professor of Structural Engineering, New York University, New York City. S. K. Barrett, H. C. Wessman.

SAVAGE, HOWARD W., Instructor in Graphics, Lafayette College, Easton, Pa. F. W. Smith, Paul P. Rice.

STEVENSON, ALEXANDER R., JR., Staff Assistant to Vice President in charge of Engineering, General Electric Company, Schenectady, N. Y. M. M. Boring, A. C. Stevens.

TAYLOR, ALBERT L., Professor of Electrical Engineering, University of Utah, Salt Lake City, Utah. R. B. Ketchum, R. S. Lewis.

THOMAS, GEORGE B., Instructor in Electrical Engineering, New York University, New York City. S. K. Barrett, R. E. Brown.

THOMPSON, J. G. H., Instructor in Mechanical Engineering, Texas A. & M. College, College Station, Texas. R. L. Sackett, C. W. Crawford, V. M. Faires.

THORNE, PERLEY L., Professor of Mathematics, New York University, New York City. S. K. Barrett, D. B. Porter.

TINNISWOOD, WILLIAM W., Instructor in Civil Engineering, University of Idaho, Moscow, Ida. A. S. Janssen, R. H. Hull.

TREYBAL, ROBERT E., Instructor in Chemical Engineering, New York University, New York City. S. K. Barrett, F. C. Fair.

WALKER, ERIC A., Assistant Professor of Electrical Engineering, Tufts College, Tufts College, Mass. E. B. Rollins, F. H. Crabtree.

WOOD, MARK E., Assistant Editor of Textile World, McGraw-Hill Publishing Co., 330 W. 42nd St., New York, N. Y. M. E. Heard, O. V. Adams.

YANOSIK, GEORGE A., Assistant Professor of Mathematics, New York University, New York City. S. K. Barrett, W. R. Bryans.

135 new members

CORRECTIONS

In the supplement to the December, 1938, JOURNAL OF ENGINEERING EDUCATION, the following corrections should be made:

Minnesota, University of (page 10)—add Metallurgical Engineering.

Rensselaer Polytechnic Institute (page 23) should be included under Metallurgical Engineering.

Clarkson College of Technology (page 16) should be included under Chemical Engineering.

New Mexico State College (page 20) should be included under Electrical Engineering.

Pennsylvania State College (page 21) should be included under Fuel Technology.

Nevada, University of (page 22) should be included under Mechanical Engineering.

NECROLOGY

ALLEN ROGERS, Emeritus Head of the Department of Chemical Engineering at Pratt Institute, died at his home in Hampden Highlands, Maine, on November 4 after an extended illness. He is survived by his widow, a son and two grandsons.

Dr. Rogers was born in Hampden, Maine, May 22, 1876. He was graduated from the University of Maine in 1897, and received his Ph.D. from the University of Pennsylvania in 1902. He was an instructor in chemistry at the University of Maine from 1897 to 1900, and at the University of Pennsylvania until 1904. During 1904–05, Dr. Rogers was research chemist for the Oakes Manufacturing Company. In 1905 he joined the faculty of Pratt Institute, and in 1920 was made Head of the Department of Chemical Engineering and Supervisor of that course. These positions he filled until illness forced his retirement a year ago.

His numerous publications in the field of industrial chemistry and in leather technology are standard reference works in those subjects, especially his "Manual of Industrial Chemistry," a well-known text in many schools. He was a member of the Chemists' Club of New York, and held offices in the American Chemical Society, American Institute of Chemical Engineers, Society of Chemical Industry, American Institute of Chemists, Technical Association for the Fur Industry, American Society for Testing Materials, American Leather Chemists Association, and the Association of Consulting Chemists and Chemical Engineers. He received the Grasselli Medal in 1920 for his work on shark leather.

Dr. Roger's patience and fellowship with his former students and associates have won him not only their respect but their love, and his passing will be mourned by all who knew him.

DAN E. CARPENTER, born October 21, 1866, at Preston, Wayne County, Pennsylvania. Taught country school. Served as railway mail clerk for several years, between Scranton and Buffalo. Entered Pennsylvania State College in 1894: graduated in 1899 in electrical engineering. Manager of a town light and power plant. Designing engineer for the Sprague Electric Company. Six years with the Westinghouse Electric and Manufacturing Company. Came to the International Correspondence Schools in 1912 as a writer of texts on electrical engineering. Was made Dean of the Faculty in 1916, which office he held to the time of his death on September 7, 1938. He was a past officer of all York Rite bodies

of Freemasonary and a member of the following: American Association of Engineers; American Institute of Electrical Engineers; American Association for Adult Education; Society for the Promotion of Engineering Education.

LEON ELLIS GARRETT, head of the mechanics department, was found dead at one o'clock on the morning of October 29th. He left his home about eight o'clock the night before, telling his wife he was going for a drive, and would be back in about a half hour. Apparently feeling a heart attack coming on he had parked his car at side of road and there died. He was 66 years old.

Professor Garrett was born at Camp Point, Illinois, October 31, 1872. In 1881 he and his parents moved to Maryville, Missouri, where he was later graduated from the old Maryville Seminary there in 1894. In 1896 he was married to Miss Mary Price of Maryville, who survives him.

In 1898 Professor Garrett enrolled in the School of Mines here, from which he graduated in 1901, and that next fall he joined the faculty with which he was connected up until the time of his death. He was acting Director of the School from 1913 to 1915. In point of service, he was the oldest member of the faculty. In addition to his wife he is also survived by his father, of Sheridan, Wyoming, who is 91 years old.

COLLEGE NOTES

University of California.—The Fall Engineering Lecture was delivered on October 6 by Julian Hinds, Assistant Chief Engineer of the Metropolitan Water District of Southern California. The subject of Mr. Hinds' address was "Bring Water Across the Desert—the Story of the Building of the Colorado River Aqueduct." Interest in the speaker and his subject attracted a large audience.

According to Mr. Hinds, the Aqueduct will deliver 1500 second feet of water from the Colorado River to Los Angeles and twelve other neighboring cities. The main aqueduct and distributaries will have a total length of nearly 400 miles. Beginning at Parker Dam, the deepest dam in the world, the water will be lifted, through a succession of pumping plants, 1617 feet over a mountain range. On the aqueduct are 38 hard rock tunnels, totaling 108 miles in length. Started in 1932, this quarter-billion dollar project is now nearing completion. The magnitude of the project and the difficulties surmounted make it one of the great engineering achievements of the world.

The Engineering Lectures are given semi-annually under the auspices of the College of Engineering. Outstanding authorities in various fields of engineering are selected to deliver the addresses, which are open to the public. It is believed that an important service is being accomplished by thus bringing notable engineering accomplishments, problems, and personalities to public attention.

Colorado School of Mines.—The enrollment at the Colorado School of Mines has again exceeded all previous figures with the registration of 779 students for the fall semester.

Additions to the faculty are: John C. Reed, B.M.E. Ohio State University, M.S. University of Illinois, M.E. Ohio State University, Professor of Mechanical Engineering; Colonel C. C. Gee, Professor of Military Science and tactics; James O. Ball, B.S. and C.E. University of Colorado, Assistant Professor of Petroleum Engineering; H. M. Crain, A.B. Bethel College, M.A. Texas Technological College, Assistant Professor of English; Ronald D. Preston, P.E. Colorado School of Mines, Instructor in Mathematics.

The new geology building will be completed before January 1, so that the class rooms and laboratories provided by the three stories and basement will be available for the second semester. The

building, completely air-conditioned, will have on the main floor the departmental offices, the geology library, and a large lecture room; on the second floor the petroleum and microscopic laboratories and lecture rooms; and on the third floor the mineralogy, ore deposit, and ceramic laboratories. The basement will include a drafting room and study rooms in addition to a vault and several storage rooms.

Colorado State College.—N. A. Christensen has been appointed Professor of Civil Engineering and Dean of the Engineering Division. Dr. Christensen received the B.S. degree with major in mathematics from Brigham Young University in 1925. After teaching a short time in the public schools of Utah, he went to the University of Wisconsin as research assistant and received his B.S. in C.E. degree in 1928, being an honor graduate of the school of Civil Engineering.

In 1933, Dr. Christensen went to the California Institute of Technology where he received the M.S. degree in 1934 and the Ph.D. degree in 1938. While at the California Institute of Technology he taught courses in engineering mechanics, strength of materials and hydraulics and in addition carried on extensive research work in the field of hydraulics.

J. Richard Osborn has been appointed as an instructor and testing engineer in Civil Engineering. Mr. Osborn received his B.S. degree from Purdue University and his M.S. degree from Texas A. & M. College. He has also had considerable experience with the Illinois State Highway Commission, the Indiana State Highway Commission, the Indiana Board of Health, and the U. S. Coast and Geodetic Survey.

Fred B. Beatty, who has been appointed as Associate Professor of Electrical Engineering, received his B.S. in E.E. degree from the Missouri School of Mining and Metallurgy in 1929. He was an instructor in Electrical Engineering at the Georgia School of Technology from 1929 to 1936, receiving his M.S. in E.E. degree from that school in 1934. In 1936 Professor Beatty was appointed Assistant Professor of Electrical Engineering at the University of Kentucky where he remained until he joined the staff at Colorado State College.

University of Colorado.—The section of the campus occupied by the engineering buildings has changed greatly in the last year. A new administration building was completed this past summer at a cost of approximately $200,000, including the furniture. The building follows the "University of Colorado" style of architecture, an adaptation of countryside architecture in northern Italy. The treatment of mass and form in the Engineering Administration Building conforms with other campus buildings. Architecturally,

the structure is considered one of the best on the campus. It is I-shaped, 43 feet long, 95 feet wide at the towers, and 51 feet wide between the towers. It will accommodate 1,100 students at one time.

This building will furnish accommodations for the Dean's office, the Engineering Library, and all the departments formerly housed in Engineering III, which was razed to make room for the new University library.

The College of Engineering will also have a new addition to Engineering II to provide for shops and laboratories. This addition, now in the process of construction, will consist of two bays, 40 by 80 feet, costing $45,000.

An important change has also occurred in the faculty. Henry Coles, head of the Chemical Engineering Department for the past two years, resigned to accept a position as head of the Department of Chemical and Metallurgical Engineering at the University of Alabama. Carl W. Borgmann has been appointed to fill the vacancy created by Dr. Coles' resignation. Dr. Borgmann comes well qualified to carry on the work of the rapidly growing Department of Chemical Engineering. He received his B.S. degree from the University of Colorado in 1927, worked with the Bell Telephone Laboratories until he went to Cambridge University in 1931, and obtained a Ph.D. degree from there in 1934. Dr. Borgmann's college career also includes a year in Scandinavian schools, two months at the Norges Tekniske Høgskole (Trondheim), and eight months at the Metallografiska (Institutet (Stockholm). Dr. Borgmann came to the University directly from Pittsburgh, where he was research engineer for the National Tube Company.

Columbia University.—The following new junior appointments to the teaching staff were made this year:

Alvan H. Tenney, B.S., Ch.E. '33, Columbia, who was an Industrial Fellow in Organic Synthesis at the Mellon Institute of Industrial Research, was appointed as Instructor in Chemical Engineering.

In Civil Engineering, Daniel C. Drucker, B.S., C.E., '38, Columbia, was appointed Research Assistant in photoelasticity; S. Arthur Olin, B.S. in C.E., Illinois '38, and Harold C. Sperry, B.S. in C.E., Maryland '38, were appointed Research Assistants in soil mechanics.

Egbert C. Ingalls, C.E. '34, D.C.E. '37, Rensselaer Polytechnic Institute, was appointed Instructor in Civil Engineering, assisting in the instruction in strength of materials, design, and in plate girder research.

Thomas M. Herbert, B.S. in C.E. '38, Vermont, was appointed Research Assistant in reinforced concrete.

Russell M. Cornell, B.C.E. '36, M.S. in C.E. '38, Minnesota, was appointed Instructor in Civil Engineering to specialize in transportation; Arthur E. Matzke, A.B. '28, B.S. '29, C.E. '30, Columbia, who was in Construction Engineering work until 1934 and since then Research Assistant in hydraulics and fluid mechanics, was appointed Instructor in Civil Engineering.

Ingvald E. Madsen, B.S. in C.E. '33, M. I. T., during 1934–36 Research Fellow at Lehigh University, and until 1938 the Maintenance of Way Department of the Pennsylvania Railroad, was appointed as Associate in Civil Engineering to carry on research work in tests of plate girders.

In Electrical Engineering, David DeWitt, A.B., B.S., M.S. (E.E.) '38, Columbia, and Theodore J. Nagel, A.B., B.S., M.S. (E.E.) '38, Columbia, were appointed Assistants in the electrical machine laboratories.

In Mechanical Engineering, Elmer Lloyd Devor, B.S. in I.E. '38, Pennsylvania State College, who has had industrial experience with the textile machine works in Wyomissing, Pennsylvania, was appointed Instructor in machine design.

Eugene N. Cameron, B.S. '32, New York University, M.A. '34, Columbia, who was Emmons Memorial Fellow in Geology in 1935–36 and Assistant and Lecturer in mineralogy until 1938, was appointed as Lecturer in geology, giving instruction in Engineering Geology and assisting in Petrology.

Melvin Avrami, B.S. '33, M.S. '35, Ph.D. '38, Chicago, trained particularly in Physics and Physical Chemistry and was employed at the Gary Works of Carnegie Illinois Steel Corporation for a short time, was appointed an Associate in Metallurgy; Frank Schnettler, B.S. '35, Cooper Union, was appointed Associate in Metallurgy; Bernard R. Queneau, Met.E. '33, Columbia, Ph.D. '36, Minnesota, was with the United States Steel Corporation at Kearney, New Jersey, and Duquesne, Pennsylvania, was appointed Instructor in Metallurgy to specialize in Ferrous Metallurgy; Joseph K. Stone, B.S. '36, Lehigh, and since then in the United States Steel Research Laboratory at Kearney, New Jersey, was appointed Assistant in Metallurgy.

University of Dayton.—John A. Elbert, S.M., has been appointed President of the University of Dayton, and M. E. Haas, S.M., has been appointed to replace Bernard T. Schad as Dean of the College of Engineering. Dr. Schad is now responsible for the educational program of the schools and colleges conducted by the religious body known under the name of Society of Mary, Province of Cincinnati. Other changes in the Engineering College are the additions of Ernest O. Brown and Thomas Williams, both Professional Engineers of Dayton. They are both instructors in the

Civil Engineering Department. The number of students enrolled in the Engineering College is 184 for the day classes. There are over 100 enrolled in engineering subjects for the night classes.

Ecole Polytechnique.—The following changes and additions have been made to our teaching staff:

Professor Armad Circé has been nominated as Dean of the Faculty.

Three young graduates have been attached to our laboratories. They are: Messrs. Jacques Laurence, laboratory assistant in the Department of Electricity; Léonard Cartier, laboratory assistant in the Department of Hydraulics; Jacques Hurtubise, laboratory assistant in the Structural Materials Laboratory.

University of Florida.—Joseph Weil, formerly head of the Electrical Engineering Department, who was acting Dean during 1937–38, has been made Dean of the College of Engineering. Dean Weil has been continuously connected with the university since 1921 and holds degrees from Johns Hopkins University and the University of Pittsburgh. He will continue to direct the work of the Electrical Engineering Department.

J. W. Mason resigned as Assistant Professor of Chemical Engineering and has been replaced by Ralph A. Morgen as Professor of Chemical Engineering. Dr. Morgen holds a Ph.D degree from the University of California and has had extensive teaching and industrial experience.

Other staff changes include promotion of G. O. Phelps from instructor to assistant professor of industrial engineering and granting of leave of absence to associate professor C. H. Janes of the Mechanical Engineering Department. Edwin S. Frash, who holds the degrees of B.S. and M.E. from Purdue University takes Professor Jane's place. R. A. Thompson has been promoted from instructor to Assistant Professor in Mechanical Engineering.

The Civil Engineering Department will move into the new Hydraulic Laboratory Building before the first of the year. This building is of reinforced concrete construction of brick and stone exterior, and measures approximately $40 \times 90 \times 50$ feet high. The Hydraulic and Sanitary Laboratories are housed in this building and it will also provide offices and class rooms for the Civil Engineering Department.

The new laboratory will contain, among other features, the ability to pump water up to 10,000 gallons per minute at 50 feet head, and 500 gallons per minute at 400 feet head. The principle of recirculation of the water through several independent measuring devices will be practiced. Another important provision for the study of hydraulic problems in Florida is the incorporation of a constant head tank for supplying large quantities

of water under heads up to 10 feet. The Hydraulic Laboratory is the second unit in a group of buildings which will provide a new location for the College of Engineering and suitable facilities for the Engineering Experiment Station.

The Chemical Engineering Department is moving from the Chemistry Building into the quarters formerly occupied by the Civil Engineering Department in the engineering group. This will provide them with much larger and more satisfactory quarters.

The Electrical Engineering Department have now located their Communications Laboratory on the eleventh floor of the new Seagle Building, where all work in electronics and communications will be conducted. A number of educational exhibits which visually illustrate principles in the communications field, have been prepared under the direction of Professor S. P. Sashoff.

The Mechanical Engineering Department has completed an additional "year-round" experimental air conditioning unit incorporating full automic control. A new wind tunnel for aerodynamics instruction will be completed about February 1st.

University of Hawaii.—A new 300,000 pound compression tension testing machine has recently been delivered by Tinius Olsen and Co. This will be set up in the engineering laboratory. This laboratory now has three machines: one of 20,000 pound capacity, one of 150,000 pound, and one of 300,000 pound. Prof. W. J. Holmes is in charge of the testing laboratory.

A new Social Science Building has just been erected and is now in use. A Union Building for student activities, a Home Economics Laboratory, and laboratories and offices for the Agricultural Experiment Station and Extension Work are now in the course of erection on this campus. Part of the funds for these buildings has been received through P.W.A. grants.

Howard University.—Three promotions in the School of Engineering and Architecture, effective at the beginning of the school year 1938–1939 were the following: George Maceo Jones, from Assistant Professor of Architecture to Associate Professor of Architecture. Associate Professor Jones holds a Bachelor's and a Master's degree in Architecture and a Doctor of Philosophy degree, all from the University of Michigan.

Ernest Rivers Welch, from Instructor in Electrical Engineering to Assistant Professor and Head of the Department of Electrical Engineering. Assistant Professor Welch holds a Bachelor's degree in Electrical Engineering from Howard University and a Master of Science degree from the University of Michigan.

Addison Edward Richmond, from Instructor in Civil Engineering to Assistant Professor of Civil Engineering. Assistant Professor Richmond holds a Bachelor of Civil Engineering and the pro-

fessional degree of Civil Engineer from the Ohio State University. Before coming to Howard University he had been a construction engineer and an assistant research engineer with the Duriron Company at Dayton, Ohio.

Erskine Goode Roberts is on leave of absence as Instructor in Mechanical Engineering, to accept a position as Assistant Engineer in the Power Division of the Public Works Administration. Mr. Roberts holds the degree of Master of Science from the Massachusetts Institute of Technology. He has been succeeded at Howard University by Stephen S. Davis, a graduate in Mechanical Engineering of Howard University.

The Johns Hopkins University.—J. H. Lampe, Associate Professor in Electrical Engineering, is absent on leave of absence to establish a Department of Electrical Engineering at the Connecticut State College, Storrs, Conn.

J. A. M. Lyons, formerly of Pennsylvania State College, State College, Pa., has joined the faculty as instructor in Electrical Engineering.

E. L. Midgette, former Instructor of Mechanical Engineering, resigned last summer to become Fellow in Science at St. John's College, Annapolis, Md.

M. F. Spotts, formerly of the University of Michigan, has joined the faculty as Instructor in Mechanical Engineering.

A. G. Christie, Professor of Mechanical Engineering, has been elected President of the American Society of Mechanical Engineers for the year 1939.

The attendance in the undergraduate courses this year totals 317. The number of post graduate students is 44. The Night Courses in Technology has about 700 students of whom about half are candidates for a degree. Plans are under consideration for advanced courses to night students.

The new Department of Chemical Engineering continues to add much new equipment to its laboratories.

The Trustees of the University have established 15 scholarships carrying free tuition and exemption from laboratory fees, open to graduate students without condition as to residents.

J. B. Whitehead, Professor of Electrical Engineering, has been appointed Director of the School of Engineering.

W. B. Kouwenhoven, Professor of Electrical Engineering, who has served for several years as Assistant Dean has been appointed Dean of the School of Engineering.

University of Kansas.—At the beginning of this academic year there were four new members on the faculty of the school of engineering taking the place of four members who had resigned.

V. P. Hessler has been appointed Chairman of the electrical

engineering department, succeeding R. W. Warner who resigned to take a similiar position at the University of Texas. Dr. Hessler received the degree of bachelor of science in electrical engineering from Oregon State College in 1926, and the degrees of master of science in electrical engineering (1927) and doctor of philosophy in electrical engineering (1934) from Iowa State College. Dr. Hessler is the author of several papers on carbon brushes for electrical machinery.

Also new in the department of electrical engineering is Lester Zurcher who has been appointed instructor in that department. Mr. Zurcher received his B.S. in electrical engineering from Case School of Applied Science in 1932 and his master's degree from the same school in 1938. The two years prior to receiving his master's degree Mr. Zurcher was a graduate assistant in the electrical engineering department at Case.

W. W. Deschner comes to us from Pratt Institute to become assistant professor of chemical engineering. He received his B.S. in chemistry at Washburn College, and his Ph.D. from the University of Michigan. Prior to receiving his Ph.D., Dr. Deschner was employed by the Corn Products Refining Company, and later the Standard Oil Company of Indiana. He has made detailed studies on the pressure-volume-temperature relationships of propane.

Howard J. Henry has been made an instructor in the department of mechanical engineering. Mr. Henry received his B.S. degree in mechanical engineering from the University of North Dakota in 1933. After graduation he spent two years in lignite coal research with the School of Mines of the University of North Dakota and with the Lignite Combustion Engineering Co. He worked for a time for Fairbanks Morse and Company of Beloit, Wisconsin. Part of the work Mr. Henry has assumed was formerly taught by Frederick Gustafson who resigned to accept a federal appointment to the National Advisory Committee for Areonautics, Langley Field, Hampton, Virginia.

Lehigh University.—At the opening of the academic year, there were approximately 20 new members of the teaching staff.

Harvey A. Neville, formerly Associate Professor of Chemistry, became Head of the Department of Chemistry and Chemical Engineering.

Inge Lyse resigned as Head of the Fritz Engineering Laboratory of the Department of Civil Engineering to become Professor of Reinforced Concrete and Solid Bridges at his alma mater, the Norwegian Institute of Technology, Trondheim, Norway. His colleagues at the University are happy for his enlarged opportunities, but regret deeply losing him from the University.

Bruce Johnston has been appointed Assistant Professor of Engi-

neering Materials and is in charge of research at the Fritz Engineering Laboratory.

A. T. Ippen has joined the Civil Engineering staff and will take charge of the hydraulics laboratory.

Maurice Ewing of the Department of Physics has a year's leave of absence from the University and is engaged on a Guggenheim Fellowship in making a survey of the underlying geological structure of certain sections of the Atlantic Oregon by seismic methods. At his disposition for the work, the Woods Hole Oceanographic Institution has placed the yacht Atlantis, and the Bermuda Biological Station is making available in part the research vessel Culver. The expenses of the work are being borne partly by the Geological Society of America.

A new wing of the Chemistry Building, known as the Harry M. Ullmann wing, has been completed and put into service, and a new dormitory was opened for the housing of about 135 students.

The Link Belt Company has presented the Department of Civil Engineering with a mixing tank, settling tank, and sand filter as part of the equipment of a small laboratory in Sanitary Engineering.

Lewis Institute.—Fred A. Rogers, Dean of Engineering, and C. L. Clarke, Dean of Liberal Arts, were made Acting Co-Directors after the resignation of Dugald C. Jackson, Jr., became effective in August, 1938.

John F. Wagner and Everett C. Shuman were added to the Engineering faculty. Mr. Wagner, who comes to Lewis from the Buick Company in Flint, Michigan, will teach mathematics. Mr. Shuman, formerly with the Portland Cement Association, is instructor in Engineering.

J. Gardner Bennett, Civil Engineering; Herbert W. Lehmann, Mathematics; and Russell B. Parks, Engineering English, all resigned from the Engineering staff.

Rehabilitation of the Engineering School is taking place, and though the work is not completed it is well under way. Considerable new equipment has been added.

The electrical and mechanical engineering curricula have been revised. An additional course in elementary electrical engineering was added to the electrical engineering curriculum. There was an extension of the alternating current machinery courses, and the curriculum is so arranged that the student is allowed four electives.

In the mechanical engineering department, changes were made to give the student an entire year (ten hours) of electrical engineering. Two options are offered in the fourth year, a materials option and a heat and power option. The mechanical engineering student is allowed three technical electives from the fields of civil en-

gineering, electrical engineering, and metallurgy, and non-technical elective from the school of Liberal Arts.

The enrollment in the mechanical engineering division far exceeds that in the other divisions. Both the number and quality of the freshmen engineering students entering this year promise a profitable year in engineering.

Manhattan College.—Brother Amandus Leo, Dean of Engineering, announces the appointment of Clarence J. Velz, sanitary engineer, as head of the Civil Engineering Department and Professor of Sanitary Engineering. Professor Velz holds the degree of Bachelor of Science and Civil Engineer from the University of Minnesota and Master of Science in Public Health from Columbia University. He brings to his new position a wide experience in civil engineering and particularly in sanitary engineering and pollution abatement with which he has been closely identified.

The Electrical Engineering Department, under the direction of Harold G. Lockwood, has recently completed new laboratories in communications, including facilities for the study of vacuum tubes, oscillators and telephonic transmission; and in illumination, equipped for photometric and optical pyrometric work.

At present, the Civil Engineering Department is actively engaged in the construction of a new hydraulic laboratory which will emphasize open flume flow, and a soil mechanics laboratory equipped for study of the physical properties of soil. The flumes of the hydraulics laboratory will also be used for seepage and earth dam tests. In preparation for the sanitary engineering and structural engineering options to be offered, plans have been adopted for the equipment of a sanitary laboratory for analysis of air, water, milk, sewage and trade wastes. The Laboratory will be flexible to permit model study and demonstration of principles and method of treatment. In the structures option, arrangements are being made for field tests of full scale structures in New York City and vicinity, and additions are being made to the structures laboratory to permit photo-elastic study of structural models.

Massachusetts Institute of Technology.—Vannevar Bush, Vice President and Dean of Engineering, has resigned to accept the Presidency of the Carnegie Institution of Washington. Edward L. Moreland, formerly Head of the Department of Electrical Engineering, has been appointed Dean of Engineering and Harold L. Hazen, formerly Associate Professor of Electrical Engineering, has been appointed full Professor and Head of the Department of Electrical Engineering.

James R. Killian, Jr., Editor of the *Technology Review*, has been appointed to fill the newly created post of Executive Assistant to the President, Karl T. Compton. His new position becomes ef-

fective on January 1. In this new position he will take over some of the responsibilities which have been carried on by Dean Bush. He will also be Chairman of the Board of Publications of the Technology Press.

Walter C. Voss has been designated as Professor in Charge of the Course in Building Engineering and Construction, filling the vacancy caused by the death of Professor Ross F. Tucker.

Carl R. Soderberg, formerly Manager of the Turbine Engineering Division of the Westinghouse Electric and Manufacturing Company, has been appointed Professor of Applied Mechanics.

The curricula in Electrochemical Engineering, Mining Engineering and Sanitary Engineering are to be discontinued after completion of the courses by the students now enrolled. The important subjects now given in these courses will be offered in other related departments.

A new curriculum has been inaugurated in Biophysics and Biological Engineering.

The Albert Farwell Bemis Foundation for Research in Housing and the Industrial Relations Section for research activities in the broad field of industrial relations have been organized.

A new building has been added to the group in Cambridge and the School of Architecture, which had remained in one of the old buildings in Boston since the removal of the Institute to Cambridge in 1916, has now been moved to Cambridge so that all departments are now located together in Cambridge. The new building also provides additional space for engineering departments.

The new high-speed wind tunnel capable of developing air velocities of 400 miles per hour to be used for aeronautical research was dedicated September 12th.

A propeller testing tunnel for research on model ship propellers has recently been installed.

A new magnet laboratory will soon be in operation which will have three water-cooled solenoids producing fields up to 100,000 oersteds over volumes of several cubic inches. The first applications of these magnets will be to the study of splitting spectral lines, to production of temperatures below 1 degree absolute and to the study of magnetic properties of metals and alloys.

Added athletic and recreational facilities are being provided; the first item consisting of moving the running track to a new location west of Massachusetts Avenue to be followed by the construction of a new field house. It is hoped that a swimming pool may also be added to the group within the year.

Additional dormitory facilities have been provided by the acquisition of the Riverbank Court Hotel fronting on the river im-

mediately across Massachusetts Avenue from the group of academic buildings. This building will be used as a Graduate House providing accommodations for 350 students.

Registration at the Institute this year was 3,064 on September 28 of which 2,424 were taking engineering. Of this latter group 444 were in the Graduate School.

At the close of the last academic year H. G. Pearson, for nineteen years Head of the Department of English and History, retired. H. R. Bartlett has been made Acting Head of the Department.

The **Michigan College of Mining and Technology** enrolment to date totals 782 students, an increase of more than 100 over the same date last year. Of the 231 freshmen, the largest entering class in the school's history, 86.5 per cent are residents of Michigan, 9.5 per cent residents of other states, 3.1 per cent Canadians, and 0.9 per cent foreign students.

Because of increase in enrolment and the consequent growth in the problem of housing, a dormitory with living quarters for 250 students will be built. Ground for the new building will be broken this fall.

New members of the faculty are: R. R. Chelberg, instructor in chemistry, who holds the degree of M.S. from the University of Minnesota and has taught at several schools, principally at the Itasca Junior college, Coleraine, Minn., and at the Ironwood Junior college, Ironwood, Mich.; J. C. Burkholder, instructor in chemistry, who received his M.S. degree at the University of Wisconsin last spring; G. D. Strong, instructor in Mechanical Engineering, a member of last year's graduating class at Michigan Tech.; A. G. Oswald, instructor in the department of mathematics and physics, who received his M.S. degree from the University of Minnesota this year; E. G. Spacie, instructor in the department of mathematics and physics, who holds the degree of M.S. from the University of Iowa, has done graduate work at the University of Chicago, and has had several years' experience in both industry and teaching; T. F. Cocking, instructor in shops, who has for the past ten years been pattern shop foreman for the Calumet and Hecla Consolidated Copper Company.

The following promotions have been approved by the board of control: R. M. Dickey, from associate professor of geology to professor. He has been head of the department for the past two years.

U. J. Noblet, from assistant professor to associate professor of forestry.

J. H. Service, from assistant professor to associate professor of physics.

T. C. Sermon, from instructor to assistant professor of mathematics.

H. W. Hawn, from instructor to assistant professor, department of mechanical engineering.

C. A. Newcomer, from instructor to assistant professor, department of modern languages.

R. F. Makens, from instructor to assistant professor, department of chemistry.

Frank Fisher, from assistant in research to instructor, department of metallurgy.

G. S. Schjonberg, from laboratory assistant to instructor, department of electrical engineering.

On October 7 and 8 Michigan Tech. was host to the annual meeting of the North-Midwest Section of the Society for Promotion of Engineering Education, comprising Iowa State College, Marquette University, the University of Wisconsin, the University of Minnesota, and Michigan Tech. Visitors from the University of Illinois and Michigan State College also attended the meetings. One hundred thirty-three registrants took part in the meetings and social functions. Among the speakers were Dean M. L. Enger of the college of engineering of the University of Illinois; President Grover C. Dillman of Michigan Tech.; James Fisher, dean of the faculty at Michigan Tech.; George Swenson, head of the department of electrical engineering at Michigan Tech. and outgoing president of this section of the S. P. E. E.; and J. H. Mathews, head of the department of chemistry at the University of Wisconsin. Group conferences were held in four branches of engineering and in English.

University of Michigan.—*Enrollment.* The enrollment in the College of Engineering has reached its all time peak this year with a total of 2,283. There are some significant facts in the subdivision of this enrollment. The present Freshman Class numbers 517, the Sophomore Class 484, the Junior Class 554, and the Senior Class 492. There are 224 Graduate students. Special attention is called to the fact that the Junior Class is the largest. Under the usual circumstances this is not at all reasonable. It happens however that there are eleven Junior Colleges in the State of Michigan which send a considerable number of their men as Juniors to the College of Engineering of the University of Michigan. It turns out then that even with a 50 per cent loss in the Freshman Class by the time the men are Juniors the present Junior Class numbers 554 against our largest Freshman Class of 517.

The Department of Mechanical Engineering reports that R. S. Hawley is on leave of absence for the first semester in order that he may make a study of a number of large steam power stations. The book on Internal Combustion Engines formerly prepared by

Professors Lay and Good has been revised recently with E. T. Vincent as another co-author. This is being tried out in mimeographed form this year.

The Department of Engineering Research reports the following list of projects now in progress:

Development of steels for high temperature service.
Quantitative spectrographic analysis.
Food preservation.
Development of soya bean products.
Sound proofing materials.
Machinability of ferrous metals.
Bearing power of soils.
Protective value of hot dipped coatings.
Firing characteristics of stoker coals.
Non-aqueous heating medium to replace high-pressure steam.

Chemical Engineering Department.—The Second Fall Technical Conference, sponsored jointly by the American Foundrymen's Association, University of Michigan, and the Detroit Chapter of A. F. A., and held at the Union Building, University of Michigan, Ann Arbor, Mich., September 15, 16, and 17, was a decided success. Thursday morning, September 15, was devoted to a discussion of malleable iron problems. The afternoon session, at which E. R. Darby, Federal-Mogul Corp., Detroit, presided, was devoted to discussions on the age-hardening of cast metals. Friday morning, Sept. 16, was devoted to discussions on cast iron theory. On Friday evening, the Conference dinner was held. The Committee was fortunate in having W. J. Cameron, Ford Motor Company, Detroit, as the principal speaker. Mr. Cameron gave an inspiring address on the part the technical man has played, now is playing and will play in the future development of our country. A. E. White, director, Department of Engineering Research, University of Michigan, acted as toastmaster.

University of Minnesota.—W. B. Lacabanne from the University of California has joined the staff of the School of Mines and Metallurgy as an instructor in Petroleum Engineering. Mr. William Muckenhirn, a Canadian, has been added to the Electrical Engineering faculty as an instructor. He received his Master's degree at Massachusetts Institute of Technology and is working toward his Doctor's degree at Minnesota. H. W. Barlow is at New York University on an exchange professorship for one year. In his place is F. K. Teichmann of New York University. Both men are working toward advanced degrees. S. M. Serebreny has been appointed as instructor in charge of meteorological work.

The first Mineral Industries Conference of Missouri was held

in Rolla on the campus of the **Missouri School of Mines and Metallurgy** on October 21 and 22, with approximately 200 delegates and guests present. The meeting was called by William R. Chedsey, Director of the School of Mines and Metallurgy, and H. A. Buehler, Head of the Missouri Geological Survey, with the object of better acquainting the mineral industries of Missouri with the services which these two institutions, in conjunction with the United States Bureau of Mines through its Mississippi Valley Experiment Station located on the campus of the school, had to offer to the industries of Missouri. Technical papers dealing with the various phases of the mineral industry were read.

As an outgrowth of the Conference a committee of 30 is to be organized in Missouri for the purpose of bringing about a closer relationship between the mineral industry with the service institutions maintained by the State and the Federal Government in Missouri for the aid of the mineral industry, and also to secure more adequate support for these service institutions. John Prince, President of the Stewart Sand and Gravel Company in Kansas City, was appointed Chairman of a committee of three to bring about the permanent organization of the committee of 30. Mr. Prince is to be assisted on the committee by G. C. Smith, Assistant to the President of the Missouri-Kansas and Texas Railroad Company in St. Louis, and W. M. Weigel, Mineral Technologist of the Missouri Pacific Railroad Company in St. Louis. The permanent committee and its organization will be announced later.

The corner-stone of Harris Hall, the new civil engineering and hydraulics building, was laid on November 14th. The building was named in honor of E. G. Harris, Professor Emeritus of Civil Engineering, who has been connected with the School of Mines since 1891. With Wm. R. Chedsey, Director of the School of Mines, presiding, talks were made by Henry E. Riggs, President of the American Society of Civil Engineers, E. M. Bayse, Assistant State Director of the Works Progress Administration, and by Ray F. Rucker, Superintendent of the Aluminum Ore Company of East St. Louis and National President of the Alumni Association. Professor Harris sealed in the stone.

This building will house the Departments of Civil Engineering and Mechanics. The total cost of the building will be approximately $90,000, of which $30,000 in materials and technical supervision is furnished by the School, while the remaining $60,000, which will largely consist of labor and some material, will be furnished by the government. This project is being built under W. P. A. The building will be a three story and basement unit, 40×120 feet in plan. The construction is reinforced concrete frame with native dolomite curtain walls and facing, with con-

crete floors, stairs and fireproof partitions. The building will be fire-proof in every respect. The basement is to contain water storage tanks, flumes and heavy hydraulic equipment, materials testing laboratory, highway materials, bituminous and soils testing laboratories. The first floor will contain an experimental hydraulic laboratory, lecture room, with a demonstration flume, surveying instrument locker room and office space. The second and third floors will contain lecture rooms, laboratory and office space.

If this building is constructed as now planned, the Missouri School of Mines and Metallurgy will be equipped with one of the most modern hydraulic laboratories in the middle west.

The School is now purchasing the latest equipment obtainable for the hydraulics laboratory. Also entirely new equipment is being purchased to equip the Civil Engineering department to handle latest laboratory practice in soils mechanics and highway materials testing.

The investigating committee on the Engineer's Council for Professional Development on its recent visit to the School of Mines noted as the principle deficiency of the Civil Engineering department its lack of a hydraulics laboratory. This new laboratory unit should more than meet the highest expectations of this committee on its next visit to the School.

Norwich University opened this year with the largest entering class and largest student body in its history. John M. Thomas, Chairman of the Administrative Committee which directs Norwich affairs while President Porter Adams is on leave of absence, has taken up residence in Northfield and will devote his entire time to the University. Twenty-two years as successful leader of Middlebury, Penn. State, and Rutgers fully qualifies Dr. Thomas for this position.

Dr. Thomas has announced the appointment of three new faculty members teaching engineering students. These new members are Alton D. Taylor, who will be Associate Professor of Engineering Mechanics; Sumner H. McIntire, who will be Instructor in Mathematics and Physics; Chester P. Hartford, who will be Instructor in English and Modern Languages.

Alton D. Taylor, who fills the position made vacant when Gerner A. Olsen accepted a position at Rutgers, graduated from Rensselaer Polytechnic Institute in 1928 with an Electrical Engineering degree, received his Master's degree from Colgate in 1933, and has completed the necessary course work for his Ph.D. in Civil Engineering at Purdue. Following graduation he was an instructor in Civil Engineering at Rensselaer for three years. He then became Instructor in Physics at Colgate, remaining for two years before leaving to take graduate work at Purdue. For four

summers he worked as an inspector and supervisor of highway construction in the New York State Department of Public Works. In 1935 he was appointed Assistant Professor of Civil Engineering at the University of Mississippi, from which post he came to Norwich.

Sumner H. McIntire returned to Norwich this year as a member of the regular staff. In 1936–1937 he subsituted for Professor Baker in the Chemistry Department while the latter was on leave of absence to complete the course work for a Ph.D. During 1937–1938 he taught science and mathematics at Thorton Academy, in Saco, Maine. At Norwich during the coming year he will work under Professors Woodbury and Dix, relieving the greatly increased teaching strain brought about by the increased enrollment. McIntire is a graduate of Bowdoin, Class of 1933, attended Harvard Graduate School in 1933–1934, and has taken summer courses at New York University. His teaching experience, in addition to that already mentioned, includes two years at Westbrook Junior College.

Chester P. Hartford graduated from Norwich in 1931, after which he joined the teaching staff of the Northfield High School and continued his Norwich association through the University basketball team, which he coached for several years. Summer school courses at the University of New Hampshire and the University of Vermont have brought him through the course requirements for the Master's degree. This year he is assisting Coach McCallister with the football squad.

Oregon State College.—Final registration figures for the School of Engineering and Industrial Arts shows an enrollment of 871 students, an increase of almost five per cent over last year.

In the Industrial Arts Department, R. C. Rhynearson has been promoted to Associate Professor and placed in charge of personnel and advisement service for students in the Industrial Administration curriculum.

In the Civil Engineering Department, R. S. Ayre has been added to the staff as an instructor to replace Grant Robley who has been granted a leave to fill a graduate assistantship at Yale University. Mr. Ayre comes to the college from Stanford University where he was for two years a graduate assistant and obtained the advanced degree of Engineer in Civil Engineering.

R. E. Summers, Associate Professor of Mechanical Engineering, resigned his position during the summer to accept a position of similar rank at the University of Minnesota. He has assumed duties there and in addition to development of several courses will carry forward his research work on boiler feed water and corrosion. It will be remembered that Professor Summers is the author of a

number of publications in this field, including a bulletin of the Oregon State College Engineering Experiment Station. This is Bulletin No. 5 carrying the title "Boiler-Water Troubles and Treatments with Special Reference to Problems in Western Oregon." A. D. Hughes, graduate of Washington State College with the B.S. and M.S. degrees in Mechanical Engineering was appointed with the rank of instructor as of October 1 to fill the vacancy created by the resignation of Professor Summers. Mr. Hughes comes to his new position with several years of engineering and teaching experience.

G. S. Feikert, Chief Engineer of the State Educational Radio System, has been appointed an Assistant Professor of Electrical Engineering, and will devote part time to instructional and research duties in that department. Through this arrangement, the facilities of the radio system, including the 1000-watt Western Electric transmitter located at Oregon State College, are available for instructional and research purposes. Mr. Feikert holds the degrees of M.S. and E.E. from this institution. A. L. Albert has been promoted to Professor of Communication Engineering.

Professor J. H. Batcheller of the Mining Engineering department has been granted a leave of absence for travel and study.

Purdue University.—After forty-five years of service, Professor W. K. Hatt will retire, January first next, from active duty, with the title of Emeritus Professor of Civil Engineering. Following a short period of travel to Australia, he will maintain residence at Purdue University.

Syracuse University.—Allen P. Cowgill, of Fort Wayne, Ind., was appointed Instructor in Applied Mathematics, succeeding Harold Allen, who resigned to take graduate work at Harvard University. Dr. Cowgill was graduated from the U. S. Military Academy in 1914 and received his A.M. and Ph.D degrees from the University of Nebraska. During the war, he served with the rank of Major as troop training officer in the Corps of Engineers, United States Army. He retired from military service in 1919. His technical experience includes teaching mathematics at West Point and the University of Nebraska. Dr. Cowgill is a member of the American Mathematics Society.

Francis Coolidge Bragg, of Bristol, R. I., was appointed Instructor in Mechanical Drawing, succeeding Mr. Stewart P. Darrow who resigned to accept the position of vocational counsellor in the Solvay, N. Y., high schools. Mr. Bragg prepared for College at the Foxboro, Mass., high school and Deerfield Academy, and was graduated from Worcester Polytechnic Institute in 1924 with the degree of B.S. in Mechanical Engineering. He is a member of Tau Beta Pi and Sigma XI. His practical experience following

graduation from Worcester Polytechnic Institute includes work in connection with the construction of the Colfax Power plant, Duquesne Light Co., the U. S. Rubber Products Inc., and with the Franklin Research Co., of Philadelphia, Pa.

The graduate assistants in the College of Applied Science are:

Ernest S. Cramer, B.S. in Chem. Eng., Bucknell, 1938, Assistant in Chemical Engineering;

L. Webster Frayer, B.M.E., 1937, B.M.E., 1937, Syracuse, Assistant in Mechanical Engineering and Mechanical Drawing;

William Hovemeyer, B.E.E., 1938, Syracuse, Assistant in Mechanical Drawing;

Malcolm L. Land, B.M.E., 1937, New York University, Assistant in Applied Mathematics;

Charles Price, B.E.E., 1935, Syracuse, Assistant in Mechanical Drawing;

A. Raymond Moses, B.Chem.E., 1938, Purdue, Assistant in Chemical Engineering;

Eldon D. Sewell, B.C.E., 1938, Oklahoma A. & M. College, Assistant in Drawing;

Harold E. Sewell, B.C.E., Oklahoma A. & M. College, Assistant in Mechanical Drawing;

William M. Stube, B.S. in M.E., 1937, Duke University, Assistant in Mechanical Engineering.

Tulane University of Louisiana is proud to announce the establishment of a unit of the Reserve Officers' Training Corps of the U. S. Navy on the campus and the enrollment of the full first year's quota of 76 candidates. This unit is the eighth to be established at outstanding universities throughout the country: Harvard University, Yale University, Northwestern University, Georgia School of Technology, University of Washington, University of California and University of California at Los Angeles having previously established units. This Corps is one of the principal sources of trained line officers of the Naval Reserve and is a very important adjunct to the National Defense.

The Naval Staff at Tulane consists of Captain Walden L. Ainsworth, Lieutenant Commander Ralston B. Vanzant, Lieutenant Jacob E. Cooper, and four Chief Petty Officers. The old gymnasium has been completely renovated and altered to house the Naval Unit and the Navy Department has been very generous in supplying equipment for use in the Naval Science course.

The course in Naval Science and Tactics requires four years, divided into periods of two years each. The first period is known as the Basic Course and the second period as the Advance Course. Upon satisfactory completion of the four-year course, the Re-

serve Officers' Corps student is eligible for a commission as an Ensign in the Naval Reserve or Second Lieutenant in the Marine Corps Reserve.

The Naval Science courses require three hours of classroom instruction and one hour of drill or practical work per week. Practice courses of three or four weeks' duration will be made each summer on battleships or destroyers. The government provides all uniforms, text books, and equipment and also pays a subsistence allowance during the Advance Course and on the summer cruises.

Entry into the Naval Unit is open only to freshmen; it is expected that about 75 freshmen will be enrolled each year so that in the fall of 1941, when the present Reserve Officers' Training Corps freshmen become seniors, the unit will reach its full authorized strength of two hundred. The number of applications this year far exceeded the quota.

The College of Engineering at Tulane changed its system of grading this fall to the letter-grade and quality point system as most widely used in universities throughout the country. It is expected that this will facilitate the transfer of credits with other universities. Numerical grades have been given in the past.

Warren E. Wilson has been appointed Assistant Professor of Civil Engineering to teach Hydraulics, Sewerage, Water Supply and Topographical Drawing. He is a graduate of Lehigh University and holds a Master of Civil Engineering degree granted by Cornell University in 1932. He has since done advanced work at California Institute of Technology and University of Iowa. Professor Wilson comes to Tulane from the South Dakota School of Mines where he served as Assistant Professor of Civil Engineering and was also a Professional Engineer in private practice. He is a member of the American Society of Civil Engineers; American Association for the Advancement of Science, Society for the Promotion of Engineering Education and Society of the Sigma Xi.

The Department of Chemical Engineering has a new faculty member in the appointment of Assistant Professor Francis McBryde Taylor. He holds a B.S. and M.S. in Chemical Engineering from the Virginia Polytechnic Institute, the latter received in 1933, and recently worked at Ohio State University toward a Ph.D. in Chemical Engineering. His industrial work has been in research on yeast foods and in pilot plant design and control. He has taught at King College, Virginia Polytechnic Institute and Ohio State University.

Joseph B. Cejka has been appointed Instructor in Mechanical Engineering. He holds a B.S. in Mechanical Engineering from Wayne University and has taken graduate work at the University of Michigan.

James A. Cronvich returned to Tulane this fall as Instructor in Electrical Engineering after spending a year in graduate study at the Massachusetts Institute of Technology. He received his B.E. and M.S. in Electrical Engineering at Tulane.

Leo Judson Kramer has been appointed Instructor in Experimental Engineering. He comes to Tulane from the Massachusetts Institute of Technology where he has acted as Instructor in Mechanical Engineering for the past two years. He holds a B.S. and M.S. in Mechanical Engineering from the same institution.

University of Virginia.—The enrollment in the Department of Engineering increased considerably this year. The total number of students registered for 1938–1939 is 245 as compared with 210 for 1937–1938. There are 90 students matriculated in the School of Mechanical Engineering; 65 in Chemical Engineering; 47 in Electrical Engineering, and 43 in Civil Engineering.

Alfred W. Fleer has been appointed Assistant Professor in the School of Chemical Engineering. Dr. Fleer is a graduate of the University of Michigan where he was a member of Phi Lambda Upsilon and Sigma Xi. Formerly Chemical Engineer and Petroleum Technologist in the Design and Development Division of Shell Petroleum Corporation in St. Louis, Missouri, Dr. Fleer will be of much aid in the development of the new program of study which has been inaugurated in the Chemical Engineering Division at the University of Virginia.

During the past year the Chemical Engineering curriculum at the University has been completely revised under the direction of J. H. Rushton, head of the School of Chemical Engineering. New courses have been added to the undergraduate curriculum, viz.: Chemical Technology, Chemical Engineering Thermodynamics, Chemical Engineering Laboratory, Design, Research, Metallurgy, and Economics. These together with Unit Operations, Physical Chemistry, and other fundamental chemistry courses constitute the framework of the new four year course. Over one-fourth of the students in the Department are registered in the Chemical Engineering course. Adequate facilities in the new Engineering Building are being rapidly developed to take care of the needs of the Chemical Engineering Division.

Under the supervision of Associate Professor F. T. Morse, members of the School of Mechanical Engineering have recently completed the wind tunnel which is the principal feature of the Aerodynamics Laboratory. Automatic electric balances have been provided so that the tunnel can be operated by a small crew. In preliminary tests, wind velocities up to 100 miles an hour have been produced upon the three foot model attached to the balances.

Assistant Professor T. H. Evans of the School of Civil Engi-

neering is building a universal frame to supplement the Bausch and Lomb polariscope used for photoelastic analysis. This fall a mercury vapor arc was purchased to complete the equipment necessary for this type of work. Professor E. W, Saunders has also completed another model bridge which will be used for practical demonstration in the courses in bridge design.

University of Washington.—The construction of a pilot plant wood pulp mill is being carried out by the Department of Chemical Engineering. In a stainless steel digester can be produced thirty pounds of pulp by any of the standard or experimental pulping processes. The pulp so produced is carried through the regular series of pulp mill operations, using small size equipment as knotter, flat screen, decker, bleacher, etc. Equipment for testing the resulting pulp is installed. It is the purpose of this equipment to make available research equipment for studying new methods of pulping, new wood species, and to collect engineering data for design purposes. For class instructional use it will be the last unit in the teaching of process development, or the carrying of a chemical process from the beaker scale to the pilot plant. All designs, patterns and equipment have been made in the departmental shop and are available to the interested schools. Operated as a W.P.A. project, the skilled labor necessary has been furnished to the department by the W.P.A.

A River-Model Laboratory, consisting of a number of sixty-foot outdoor channels, has recently been completed adjacent to the Hydraulics Laboratory. The purpose of this new addition to the Hydraulics Laboratory is to provide facilities for studying problems that arise in connection with developments within the State, of public improvements such as water supply, irrigation, hydroelectric power development and flood control. Owing to the mild climate in the Pacific Northwest, it has been possible to build the channels out of doors and thus to obtain, at a cost of approximately $20,000 a plant which would normally cost several times as much.

During the past decade many developments requiring experimental study have been undertaken within the State, but the absence of suitable facilities at the University have made it necessary to study these projects at remote laboratories outside of the State. Now that these new channels are available such studies can be completed locally. A number of projects have already been studied experimentally.

West Virginia University.—Chas. E. Lawall, Head of the School of Mines, has been elected Acting President of the University following the resignation of President C. S. Boucher, but at present has not relinquished his duties in connection with the

school. W. W. Hodge, Head of the Department of Chemical Engineering, has been granted a year's leave of absence to organize a program of research for the treatment of the industrial wastes of the steel industry as they affect water supplies. The research is sponsored by the American Iron and Steel Institute. Professor Hodge is located at Mellon Institute.

Three new instructors were added to the staff in Chemical Engineering this year. R. C. Cantelo came from the oil industry at Whiting, Indiana. O. E. Brown from the University of Wisconsin and M. J. Skeeters from Purdue University.

Much new equipment has been secured for the engineering laboratories. Mechanical engineering is completing a new internal combustion laboratory with new power brakes and two Diesel and two gasoline engines. Chemical engineering has recently obtained a new crystallizer, a humidity and temperature control dryer, a bubble cap distiller, a double effect evaporator and an Oliver Rotary Filter press.

Enrollment continues to grow, the increases for the last two years being about 10 per cent over the preceding years. A new Mineral Industries Building has been planned to relieve the present congestion in the college. It will house Mining, Chemical Engineering and Geology.

Yale University.—The following appointments in the School of Engineering are announced:

Ira T. Hook, appointed Lecturer in Materials Testing, formerly Assistant Professor of Strength of Materials in Yale University, 1920–23. He is giving us part time through an arrangement with the American Brass Company where he is Test Expert and Research Engineer. Graduate of University of Michigan, 1913 B.C.E. Recently elected Chairman of the Connecticut Section of the American Welding Society.

Fred G. Robley appointed Instructor in Engineering Mechanics. Graduate of Oregon State College degree of B.S. in C.E. 1931. Formerly Instructor in Civil Engineering at Oregon State for one year and two and one-half years District Supervisor on a Traffic Survey for the Oregon State Highway Department.

Holly A. Cornell appointed Instructor in Engineering Mechanics. Graduate Oregon State College, degree of B.S. in C.E. 1938.

Henry A. Lepper, Jr., appointed Instructor in Engineering Mechanics. Graduate of George Washington University, B.S. in C.E. 1936, University of Illinois, M.S. 1938. Assistant in Department of Theoretical and Applied Mechanics at University of Illinois for two years.

Harold E. Graves appointed Instructor in Chemical Engineering. Graduate University of Minnesota, B.Ch.E. 1932, M.S.Ch.E.

1932, Ph.D. 1935. Formerly Research Chemist Calco Chemical Co., Inc., 1935–36, Associate Professor of Ch.E., Mississippi State College 1936–38.

William Junkin Cox and George W. Colton of the Department of Engineering Mechanics have resigned. Professor Cox is now Highway Commissioner, State of Connecticut. Mr. Colton has accepted a position as engineer for the American Machinery and Foundry Company.

BOOK REVIEWS

Principles of Engineering Economy, 2nd Edition. EUGENE L. GRANT. The Ronald Press Company. 431 pages, $3.75.

To one who has read the book rather carefully the outstanding impression is that the author has compounded an excellent prescription of engineering principles, applied economics and accounting for business concerns that need physical adjustments. A quarter of a century ago it would have been heresy for an engineer to admit the importance of accounting as an aid to engineering. This book develops in a revealing manner the imperative necessity for the engineer to rely upon principles of accounting and upon facts gathered from the books of account if his cost estimates are to be accurate, meaningful and reliable. By so doing, "hunch" decisions are avoided, and are replaced by scientific forecasts which give business management facts for arriving at decisions with respect to future policies.

Part I is devoted to choice alternatives in making engineering economy studies. The need for considering choice alternatives is emphasized, as it should be, if business management is to be intelligently informed about proposed improvements or replacements and new developments.

Part II or about one-fifth of the book is devoted to the subject of interest. This important aspect of cost is surveyed from all important angles, that is from the accounting, economic and mathematic viewpoints. The accountant, the economist and the engineer each could learn something of the peculiar interest problems outside of his respective field by reviewing this treatise. This portion of the book shows the necessity for the understanding of the aspects of each viewpoint in making engineering economy studies.

Part III develops the techniques to be followed in making engineering economy studies. In making alternative studies from which decisions are made as to new developments and projects and as to replacements and improvements, the following pertinent factors are well outlined, namely, investment funds, increment costs, sunk costs, depreciation, capacity and load factors, future growth as related to immediate versus deferred investments, and break-even and minimum cost points. Chapter 15 contains some very good examples of practical replacement economy.

Part IV presents a procedure for getting results from engineering economy studies. Suggestions are offered for overcoming ob-

stacles to economy from the individual and social viewpoints. The uses of engineering reports and budgets are also commented upon.

C. L. VAN SICKLE

The Structure of Steel, first edition. 1938. ERIC N. SIMONS AND DR. EDWIN GREGORY. Prentice-Hall, Inc. 115 pages, $1.50.

Here is a little book which is well worth reading by those of us who are not metallurgists. The author explains, in simple terms, the internal structure of steel. In this work one may acquire an appreciation of the importance of the many different internal structures. One will also realize that for any particular use to which steel is to be put there is probably one steel with a particular heat treatment which is most suitable.

The author states that most of us who have to do with steel wish very much to know about steel and its structure. This book is the answer to the large majority of us who have not the basis for the study of the many metallurgical books.

M. L. RUTTER

English for Students in Applied Sciences. S. A. HARBARGER, W. R. DUMBLE, W. H. HILDRETH, AND BERT EMSLEY, of the Ohio State University. McGraw-Hill Book Co., 1938. $2.00.

This book, for the first-year college students in the applied sciences, discusses English composition in relation to student experience and life, not as an isolated subject of study.

Its purpose is to present English as "an instrument to aid professional progress and achievement." In general, it assumes that the student is adequately prepared for writing by possessing a knowledge of grammar, spelling, punctuation, and word-usage; or, if not, that he will refer constantly to handbooks and dictionaries.

The book consists of two parts. In Part I, Writing Principles, such matters are discussed as writing supplies (desk materials, paper, dictionaries, handbooks): sources of material (experience, observation, books); note-taking; outlining; kinds of functional writing to be written or used as models (professional letters, petitions, reports, abstracts, bulletins, textbooks, and general books); the expansion of the outline into paragraphs and paragraph-groups; the use of tables, graphs, diagrams, and photographs; language (precision, clearness, interest); and the final copy (revision, criticism, proof-reading).

In Part II, Writing Principles Applied, there is discussion of reports in general (kinds, procedure, use of factual description, factual narration, definition); the report of experience; the report

of observation; the simple research report (with further directions on the use of the library, indexes, encyclopedias, note-taking, bibliographies, and footnotes); and the make-up for the long paper.

The exposition of these written principles is clear: the authors, in their style and in their plan of organization, have never lost sight of the fact that they are writing for first-year college students. Like other kinds of technical composition, the content is made effective by the liberal use of varied subheadings. The numerous illustrative examples are drawn from writings on the applied sciences, and the exercises at the ends of chapters are simple, practical, and usable.

There are three appendixes. The first, as a balance to the practical nature of the book, is designed to acquaint the student with the "liberalizing possibilities of English" by giving him a selective bibliography of long and short fiction, essays, drama, biography, poetry, and books that link science to literature. The second appendix is a four-page bibliography of references on writing for students; and the third, on suggestions and references for teachers, concludes with a six-page bibliography of books valuable to those who desire to develop both the compositional and cultural capabilities of their students.

GEORGE S. WYKOFF

G-E Campus News

RAINBOW-COLORED TREASURE ISLAND

SAN FRANCISCO built the island—now, General Electric is lighting it in all the colors of the rainbow.

The lighting of the Golden Gate International Exposition, which will open in February on man-made Treasure Island in San Francisco Bay, will be the most colorful ever undertaken. For it will illuminate in all the rainbow's colors the many buildings and beautiful "courts" on the island—the Court of the Moon, the Court of the Seven Seas, and others. More than 9000 floodlights are being used. The illumination is under the direction of A. F. Dickerson, Texas A. and M. 1910, Manager of the General Electric Illuminating Laboratory, at Schenectady.

The "rainbow of light" for the San Francisco Fair will be another in a series of spectacular lighting projects that have illuminated Chicago's Century of Progress, Brazil's Centennial Exposition, the Texas Centennial, and others. And as G-E engineers develop the project for San Francisco, again they are being aided by recent engineering college graduates and ex-Test men—the men who will design brilliant exposition lighting in the future.

OPPORTUNITY FOR RESEARCH

SELECTED graduates of American Colleges carry on research work each year in chemistry, physics, and physical chemistry with the aid of Charles A. Coffin Foundation Fellowships. These fellowships were established by General Electric in 1922 in honor of the Company's first President, Charles A. Coffin.

The awards are made by a committee of distinguished men. This year the committee consists of Dr. Bergen Davis, representing the National Academy of Sciences; Dr. Karl T. Compton, of the Society for the Promotion of Engineering Education; and Dr. John C. Parker, of the American Institute of Electrical Engineers. The candidates' applications, together with the faculty recommendations forwarded to General Electric by the various colleges, are the basis for the awards.

This year, applications for the fellowships must be in the hands of the Secretary of the Charles A. Coffin Foundation Committee, at Schenectady, on January 15, 1939.

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NEW BOOKS

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Coming this spring

PROBLEMS IN MECHANICS

By G. B. Karelitz, J. Ormondroyd, and J. M. Garrelts

This new book contains nearly 800 problems on the application of the principles and theorems of mechanics to practical engineering. The famous collection of problems by I. V. Mestchersky is the basis of the book, but these original problems have been transposed to suit American practice and supplemented by a great many new problems. All the problems are outstanding for their practical value and for the comprehensive range of topics they cover. They can be used with any standard textbook for courses in mechanics. $3.90 (probable)

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Professor of Mechanics and Hydraulics
State University of Iowa

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